JANUARY 1961

ONE SHILLING & SIXPENCE

# FLIGHT

Aircraft, Spacecraft, Missiles

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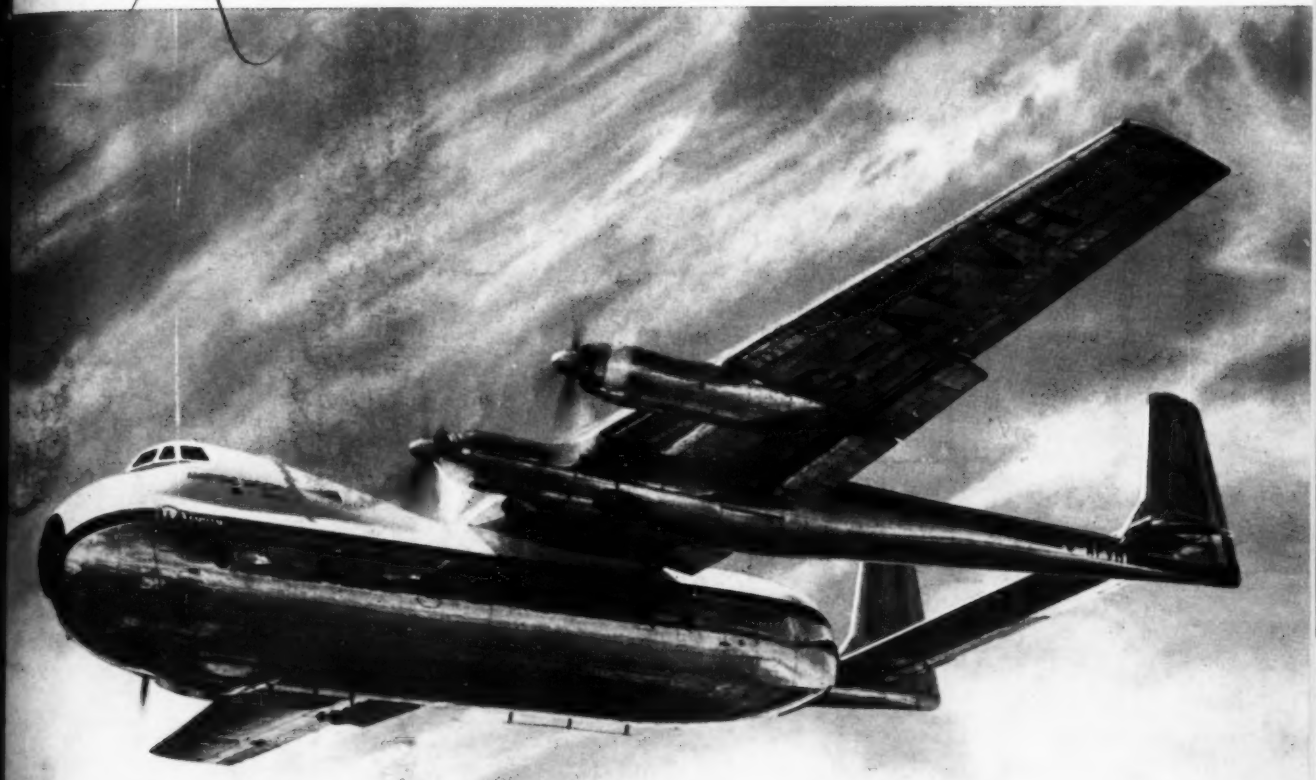

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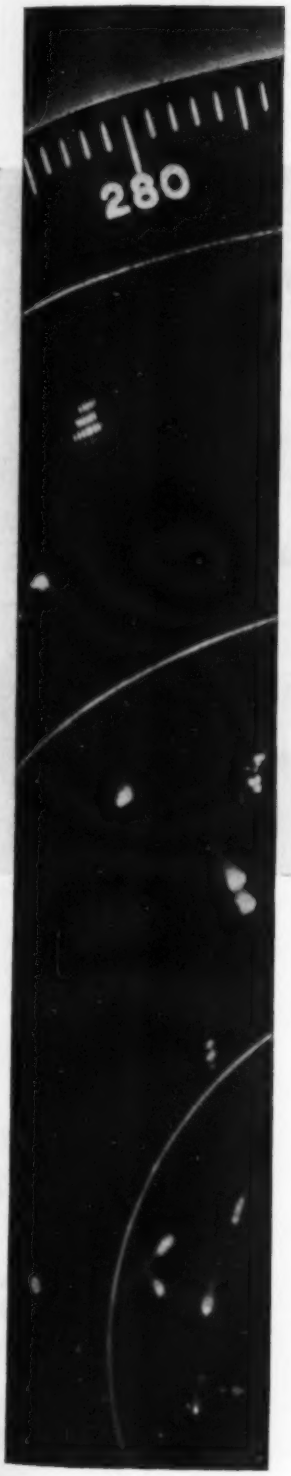


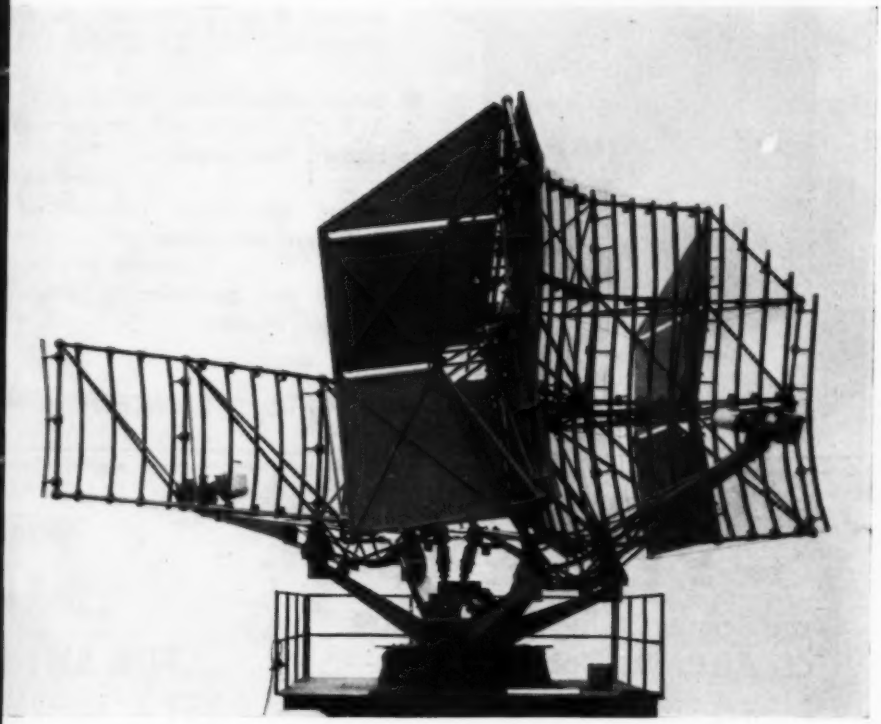

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FLIGHT

AIRCRAFT, SPACECRAFT, MISSILES

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## Jet Fuel and Safety

EVER since the jet fuel controversy flared up last July—when Lord Brabazon, speaking as chairman of the Air Registration Board, declared that the use of JP.4 was "disgraceful"—we have observed and reported subsequent rounds without comment. This was because the technical, as distinct from the emotional, case for the gasoline-based JP.4 had not been fully stated. Everything, apart from a brief TCA comment in August, had been pro-kerosine—particularly the BBC Television "fuel duel" of November 21.

Last August we invited Trans-Canada Air Lines, a greatly respected user of JP.4, to answer the allegations, in particular those made by Mr J. W. Rickard in *Flight* of June 10 last. The invitation was in due course accepted, and TCA's case for JP.4 is presented in this issue.

We are glad that we did not commit ourselves hastily, because, as with so many other controversial things in life, this is no black-or-white issue. TCA's reply is a strong one, and it had to be heard before judgment could be passed. We have studied it carefully, together with much of the learned evidence on the subject going back ten years. We now attempt a summing-up.

Three questions—in our view the fundamental ones—need answering: (1) Is kerosine, as alleged by Lord Brabazon, likely to give passengers a better chance of escape in the event of a typical minor landing or take-off accident? The answer, from which TCA do not appear to dissent, must be "YES, in general." (2) Is JP.4 safer in flight, in particular as regards the static electricity hazard, as originally suggested by TCA, and as recalled in a recent issue (December 16, page 960)? The answer, in the light of TCA's later qualified opinion on this issue, is "MAYBE; but not enough is known." (3) Is JP.4 cheaper, and is this the reason for its widening use?

This last answer depends on what is meant by cheaper. A gallon of JP.4 may cost less than a gallon of kerosine—depending where it is uplifted. But JP.4 has more heat energy per lb—at least one per cent more—and this can be a significant economic factor, especially so because operations are more often weight (i.e. payload) limited than tank limited. So the answer to the question "Is JP.4 more economic?" must be "YES, in general"—though economics are not the only reason for its use. There are technical points in favour of JP.4—for example, its low-temperature properties—but these are not primarily points of safety.

In aviation there is always the question of how much one should pay for safety. We believe that a small extra margin of safety in public air transport operations, even a *possible* small extra margin, is always worth paying a great deal for. And we now believe, in the light of all the evidence from all sides, that the opportunity for airlines to use kerosine instead of JP.4 might well offer this possible small extra margin of safety.

## Year of the UTV

AN article in this issue emphasizing the wide Naval application of rotating-wing aircraft invites conjecture as to the next major exploitation of helicopter versatility. This may well be what Sikorsky are calling their Universal Tactical Vehicle (UTV), to fly this year. A skeletal affair, it will lift and carry pods, pallets, rigs or containers. But we predict the quick demise of the term "UTV," as connoting only the military application. In prospect are a "plush passenger coach," cargo "flat cars," an emergency hospital, a mobile machine shop, a self-contained power station. As Sikorsky remark, the uses to which such a carrier may be put are limited only by the imagination.

# FROM ALL QUARTERS

*GNOMES FOR ITALY: Mr Hugh Buckingham, managing director of the de Havilland Engine Co (left) with Sr Domenico Agusta, president and general manager of the Italian Agusta company. The model is of the new Agusta Bell 204B helicopter now entering production in Milan and for which—as reported recently in "Flight"—D.H. Gnome engines have been ordered in quantity*

## The 24th Paris Show

ANOTHER notable Paris Show—the 24th—is promised this year. At Le Bourget, between May 26 and June 4, there will be a series of special "days," dedicated to air transport, private flying, rotary-wing aircraft, electronics, ambulance flying and the exploration of space. A unique feature of the 1961 Salon is that the West German aircraft industry will be taking part in a foreign exhibition for the first time, airframe, engine and equipment companies participating on a joint stand as well as exhibiting a number of aircraft.

## Tynes for Transalls

ROLLS-ROYCE have received a West German Defence Ministry contract for the supply of Tyne turboprops for the three prototype C.160 Transall military cargo aircraft scheduled to fly early in 1962. A report from Bonn gives the value of the contract as DM10.5m, or about £875,000, and it probably buys at least nine engines. Engines for production Transalls would probably be manufactured by Hispano-Suiza and FN.

## Decca Enters Space

A RESEARCH and development group for space electronics is being formed by Decca Radar Ltd. The group will be located at new laboratories on the company's site at Somerton Airport, Cowes, Isle of Wight. It is expected that initial programmes will include tracking systems and low-noise receiving systems.

## Hunting Changes

IT was announced last week by Hunting Aircraft Ltd that Sir Percy Hunting had relinquished the chairmanship of the company and that the board had elected Sir George Edwards, CBE, Hon FRAeS, Hon FIAS, executive director of the British Aircraft Corporation, in his place. This is in accordance with arrangements made in July last year when BAC acquired a controlling interest in Hunting Aircraft, Sir Percy agreeing to continue as chairman for a limited period to ensure smooth integration of Hunting Aircraft within BAC. Sir George Edwards, managing director of Vickers-Armstrongs (Aircraft) Ltd, was elected to the Hunting board last September.

Other changes consequent upon BAC's controlling interest in Hunting Aircraft are that Mr W. A. Summers, CBE, FRAeS, MIProdE, and Mr K. D. Morgan, Hunting Aircraft directors, have resigned from the boards of the following Hunting Group companies as from December 31 last year: Hunting Aviation Management Ltd, Hunting Engineering Ltd, Hunting Mhoglas Ltd and the Henderson Safety Tank Co Ltd.

## The Swiss Mirages

FROM a correspondent in Lucerne, where the competitive trials between the Dassault Mirage IIIC and Saab 35H Draken were held, we have learned some of the factors underlying the choice of the French aircraft for the Swiss Air Force. As reported last week, the Swiss required a multi-mission aeroplane, and it was felt that the French had a more highly developed weapon system, particularly in the offensive role. Although the take-off run of the Mirage was generally about 35 per cent longer, it came within the 2,000m (6,560ft) stipulated; and, although in most configurations the Draken had a better climb up to about 8,000m (26,250ft), the rocket-assisted intercepter version of the Mirage had superior performance at altitude. Our correspondent further claims that for most missions, and particularly during attack sorties, the Mirage had 140 to 200km (87 to 124 miles) greater range, and its smaller overall size made it more amenable to underground storage at Alpine bases.

*RING IN THE NEW: A Bell HUL-1 powered by the first Allison T63 turboshaft engine to be delivered. Another machine is also undergoing flight trials under US Navy contract. Hovering ceiling in ground effect is raised to 13,900ft and top speed is 105 m.p.h. Gross weight at 2,850lb is unchanged, but useful load is increased to 1,500lb*

The engine will be the SNECMA Atar 9C, and the brakes will have capacity greater than those in the French aircraft. Three or four machines are being imported from Dassault, probably early in 1963, and the 100 Swiss-built aircraft will be delivered between early 1964 and late 1966. They will cost approximately 900m Swiss Francs (£75m), of which 500m will buy the aircraft and the remainder the armament, electronics and spares.

## HSA Board Enlarged

*Mr J. T. Lidbury, new chief executive*

FIVE new directors, representing the aircraft and missile manufacturing companies in the Hawker Siddeley Group, have been appointed to the board of Hawker Siddeley Aviation Ltd. They are Sir Aubrey Burke (deputy chairman), Mr A. S. Kennedy (finance director), Mr A. F. Jopling (Blackburn Aircraft), Mr W. S. D. Lockwood (Armstrong Whitworth Aircraft) and Mr H. S. Sturgeon (de Havilland Aircraft). Mr J. T. Lidbury has been appointed chief executive and the other members of the board are as follows: Sir Roy Dobson (chairman), Mr J. A. R. Kay (sales director), Mr S. D. Davies (technical director), Mr H. Burroughes (Gloster Aircraft), Mr J. F. Robertson (group finance), Sir Sydney Camm (Hawker Aircraft) and Sir William Farren (missiles).

Commenting on the change, Sir Roy Dobson says that "this strengthened board aims at the complete consolidation and integration of all the Hawker Siddeley Group's aircraft and missile interests into one solid and powerful organization." With its recent acquisition of the Folland, Blackburn and de Havilland companies, Hawker Siddeley Aviation now has 73,300 employees.

## 1960 Exports

DURING the first eleven months of 1960 the British aircraft industry's exports amounted to £129m, engines accounting for £67m of this total. The latter figure exceeds the previous record annual total for engines (1959), which was £64½m.

Overseas sales during November totalled £12,110,049, made up as follows: aircraft and parts, £5,047,536; engines and parts, £6,475,107; electrical equipment, £283,008; instruments, £229,747; tyres, £74,651.

## Viscount 700 Speed Restrictions

LAST weekend Vickers-Armstrongs announced that operators of some Viscount 700s were being advised to inspect the wing joints of their aircraft within seven days and that in the meantime indicated airspeed should be restricted to 190kt. At 20,000ft this is equivalent to 260kt TAS.

The action follows the discovery, in two Viscount 700s operated by Central African Airways, of minute cracks in the spar-boom lug of the inner-to-outer wing upper attachment, immediately

***MISSILE PLATFORM:** Complete with four dummy Skybolt missiles (see page 44), the first B-52H was rolled out from Boeing's Wichita plant on January 5. The new bomber is powered by eight 18,000lb-thrust Pratt & Whitney TF33 turbofans, and has a 20mm GE "Gatling" in the tail (far right)*

outboard of the outer engines. The cause is believed to be corrosion. CAA have suspended their remaining two Viscounts from service.

Only aircraft with DTD 363 bottom booms—about 80 in all—are affected by the Vickers recommendation, but special ultrasonic equipment is required to detect and measure such cracks. Arrangements are being made by the aircraft manufacturers to supply the necessary equipment in cases where it is not available locally. Some 13 airlines are involved, among them BEA, who have 23 Viscount 700s. A corporation spokesman said last week that there should be little difficulty in meeting traffic requirements while the aircraft were withdrawn for inspection.

## New London Heliport?

AS part of a proposed replacement for Covent Garden market, to be built over the sidings just north of King's Cross station, the Industrial Development Corporation, a private-venture consortium of major contractors, consultants and finance houses, has proposed a heliport to handle up to 1,000 passengers an hour.

As a private venture the market is claimed to offer considerable advantages, both operationally and financially, over the Covent Garden annexe proposed as a Government project. The building would have combined road, canal and rail access right into the five-storey market and the flat roof would provide an area 800ft × 1,200ft on which helicopters could land and park. No fuel storage or major maintenance facilities are contemplated. Lifts would connect with road level and provide almost direct access to King's Cross, St Pancras and Euston stations and to the local transport services. Total cost of the market is estimated at £6,000,000 and the heliport, with basic installations, is estimated to add £1,500,000. Bad-weather approaches would be feasible, because the roof would be 120ft above ground level; and noise nuisance could be avoided. Access over built-up areas would be possible with multi-engined helicopters. Perishable produce could also be flown direct to the market.

To deal with the heliport proposal, Lord Sempill, as sole director, is reviving Central Airports Ltd, which he first founded in 1933 to build an airport over King's Cross. It was to have been capable of accepting fixed-wing aircraft.

# IN BRIEF

The first Alizé for the Indian Navy was officially handed-over at the Breguet factories at Villacoublay last Saturday. The aircraft are to be delivered at the rate of two a month.

Maj-Gen E. Moore, who commands the US 3rd Air Force in Britain, relinquishes his command in February. He is 52.

The retirement from the RAF of Air Marshal Sir Humphrey Edwardes Jones, C-in-C RAF Germany and 2nd ATAF, was marked last Friday by a fly-past at München-Gladbach of 36 jet aircraft from five NATO air forces. The new C-in-C is Air Marshal J. Grandy.

With the approval of the Minister of Aviation, the appointment of Mr C. F. Uwins as chairman and managing director of Short Brothers and Harland Ltd has been extended from January 1 this year, pending a permanent appointment.

A new women's world glider record for speed over a 300km triangular course was set up on January 8 by Mrs Anne Burns, flying a Slingsby Skylark 3b from Kimberley, South Africa, at a speed of 68km/hr (42.25 m.p.h.).

The world glider gain-of-height record of 34,300ft set up on December 16 by Dick Georgeson and described on pages 56-57 of this issue appears to have been short-lived. According to Polish reports, Stanislaw Jozefczak, flying a Mucha-100a on January 4 in a standing wave near Nowy Targ, in the vicinity of the Tatra mountains, reached an altitude of 12,600m (41,340ft) with a gain of height of 10,900m (35,760ft).

A Boeing C-97E took off from Goldsboro, North Carolina, on January 5 on a round-the-world flight to inaugurate the USAF "talking bird" communication project. The aircraft is described as being "fitted out as a command post and communications centre to test airborne communications in remote areas," and an Air Force spokesman said it was hoped the flight would lead to improved aircraft control in emergency airlifts to areas with poor communications, such as those undertaken after last year's Chilean earthquakes.

A Widgeon of British United Airways was being used last Tuesday for pipeline-laying across Cliffe Marshes, near Gravesend, Kent—the first use of a helicopter for such a task in Britain.

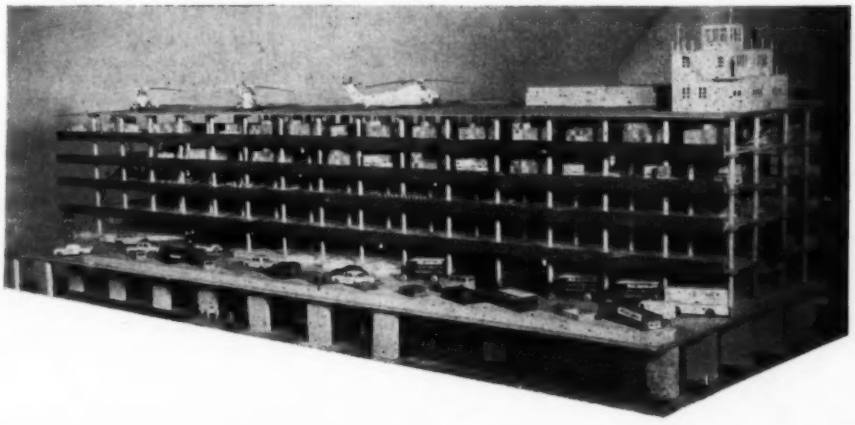
Boris Cheranovsky, described in a Moscow announcement as designer of the first flying-wing type of aircraft, has died aged 65. His obituary speaks of him as the "initiator of the tailless aircraft" and the designer of a number of flapping-wing types.

Turboméca announce that they have recently shipped Marboré turbojets for installation in two Yugoslav twin-jet prototypes, the T-451MM Straljen II (Hornet) and the S-451MM Matica (Queen Bee). The first-named is for close support; the second for training.

Next Monday (January 16) the RAF are sending a team of eight officers to compete in the 1961 bobsleigh events at St Moritz. Four two-man bobsleds and two four-man bobs have been bought, so that the team can compete on level terms on an international basis.

Air Cdre F. W. Thompson has been appointed Director of Guided Weapons (Trials) at the MoA in succession to Air Cdre W. R. Brotherhood; and Air Cdre H. M. Russell becomes Director of RAF Aircraft Research and Development (B) in succession to Air Cdre W. D. Distrey. They are taking up their new duties this month.

The French five-year weapons programme, the law for which was recently passed in the French parliament, includes financial provision for 27 Breguet Atlantic maritime patrol aircraft. A recent news item in these columns from a French source named these aircraft as Breguet Alizes, a type being procured in quantity under a separate programme.



***HELIMARKET:** The Industrial Development Corporation proposal for a five-storey market built over the sidings at King's Cross, London, with an 800ft × 1,200ft heliport on the roof. The model shows a small section of the market and roof-top with control tower. York Way passes through the farther end of the building (see news-item above)*

## Missiles and Spaceflight

# SOLID-PROPELLANT MOTORS

IN the past it has been difficult to avoid acquiring the impression that Britain has done relatively little work in the field of advanced solid-propellant rocket motors of the type which power the American Polaris or Minuteman. That such an impression is misleading is evident from some recent unclassified papers, two of which were read before the Rocket Propulsion Symposium held at Cranfield on January 6-7. Both were prepared by engineers of Imperial Chemical Industries' Metals Division, whose Summerfield Research Station, near Kidderminster, Worcs, has done as much work on solids as any establishment in Europe.

The first paper was entitled *Thrust Axis Control in Solid-Propellant Rocket Motors* and the author was J. M. Carter. His subject has superficially appeared to be dominated by the USA, and there is no record of any British government-sponsored weapon incorporating such propulsion. Mr Carter makes it clear that the SRS has investigated all practicable arrangements very thoroughly—although doubtless only in relatively small sizes.

The paper outlines some of the basic requirements for missile control about all axes. Thrust deflection required might vary between ±5°, with a frequency of 1c/s for a large vehicle and ±30° at 3c/s for a small missile; frequency of operation would be higher at partial deflections. The author discusses possible arrangements under three main headings.

*Direct mechanical interference* Simple jet vanes are illustrated above in Fig 1a. Advantages are simplicity, relatively low actuating torque and the ability to achieve large deflections; but these are usually more than outweighed by the loss in thrust (even without deflection), the fact that the nozzle must be stressed to carry the vanes and their reaction members, and the extreme difficulty of fabricating the vanes themselves. The spoiler system (Fig 1b) suffers from all these disadvantages, with the slight improvement that the spoilers are normally in the hot gas only when actually deflecting. The paddle vane (Fig 1c) virtually combines both methods, and so has similar disadvantages, plus high actuating forces and the difficulty of providing roll control. The best of this family is the jetavator [used in the current model of Polaris—Ed], illustrated in Fig 1d. Disadvantages include critical erosion at high deflections, and the fact that blow-back between the moving ring and fixed cone must be prevented by a spherical surface and sliding seal. The latter may necessitate high actuation torques, and raise problems of gas deposits and thermal expansion. The normal deflection limit of about 15° can be approximately doubled by adding a tubular extension (Fig 1e), which requires most careful design. All these arrangements suffer from the further drawback that their efficiency can be a maximum only at one fixed expansion ratio.

*Non-mechanical interference* Major disadvantages of gas bleeding (Fig 2a) are the mechanical ones involved in making a series of nozzles and valves capable of handling modern rocket gases. The varying aggregate nozzle area must result in changes in combustion pressure, and although there are ways of partially overcoming these problems, they in turn bring their own disadvantages. In Fig 2b, gas injected into the main nozzle cone causes separation from the wall and asymmetric thrust. There is no evidence that this gives more powerful control than would direct bleed of the same secondary flow to an auxiliary nozzle. A remarkable third arrangement (Fig 2c) employs a pair of coils around the nozzle through which can flow an electric current. The latter produces a strong magnetic field perpendicular to the gas flow, setting up a transverse force on each partially ionized gas particle, leading to deflection of the jet. This system might become practicable in future engines with higher combustion temperatures, possibly with cesium injection to increase the ionization.

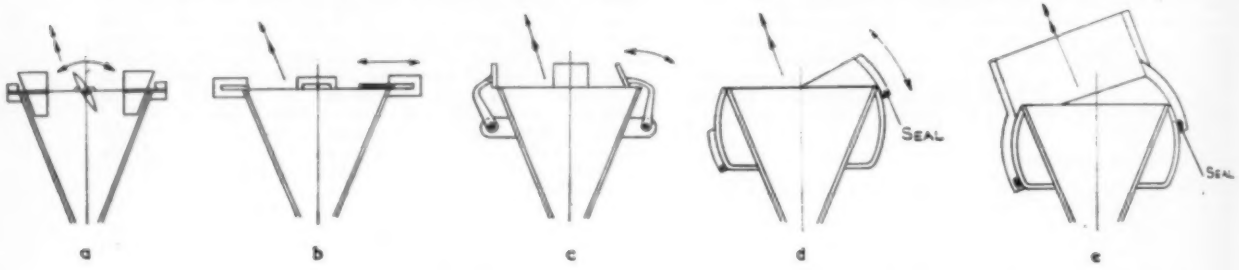



*Fig 1 Control of jet direction by direct mechanical interference. Each nozzle above, and those in Figs 2 and 3, is pointing upwards*

*Swivelling nozzles* The first arrangement in this category employs pivoted auxiliary motors (Fig 3a). Although giving excellent control in all three modes, the result is far from clean and suffers a heavy weight penalty. Much better are the swivelling-nozzle systems, of which the first type employs a metal bellows (Fig 3b). Pressure loads would be carried by external pivots, not illustrated. In Fig 3c is depicted a ball/socket arrangement, in which the sliding seal must be protected from the hot gases and also have minimum friction. Yet another arrangement involves nozzles which rotate (Fig 3d) about an axis inclined outwards relative to that of the motor. Such a nozzle requires only a simple rotating seal and thrust bearing, can be very light and fits readily into a motor end-closure.

In conclusion, Mr Carter cast a brief glance at actual hardware developed at the SRS. Typical of the very effective tubular exit-cone extension systems developed for small motors is one (Fig 4) giving ±27° deflection at 2c/s. Friction is reduced by an O-ring in p.t.f.e.; on a nozzle developing about 250lb thrust at 1,500lb/sq in chamber pressure the maximum deflection required

*Fig 2 Control of jet direction by non-mechanical interference (left, below)*

*Fig 3 Control of jet direction by nozzle rotation (right)*

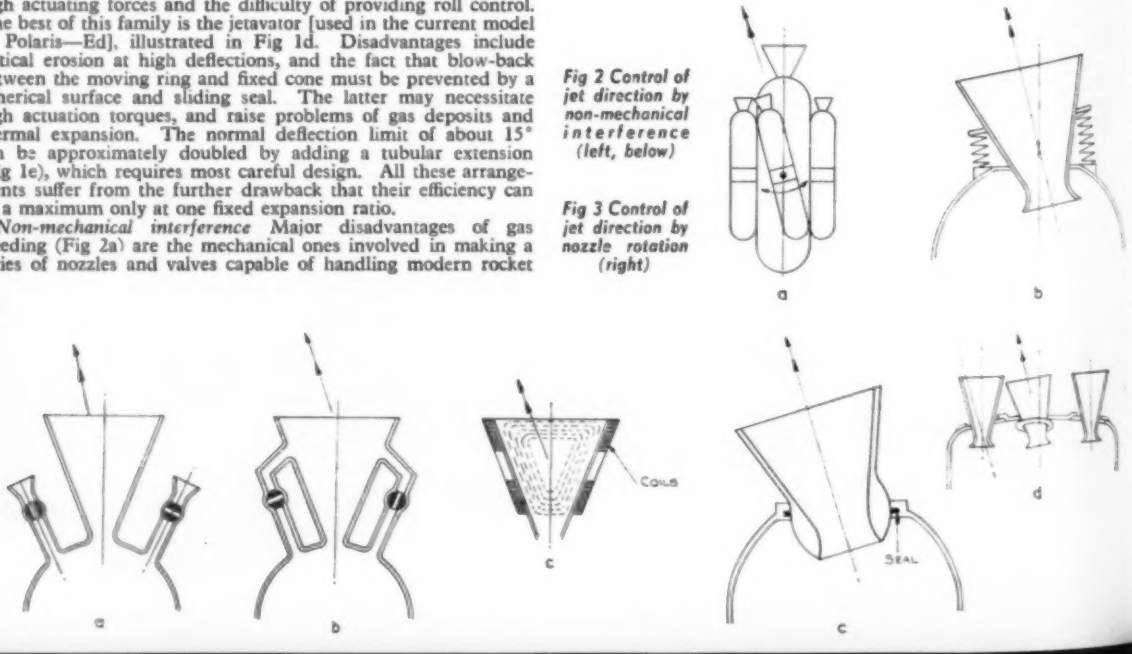
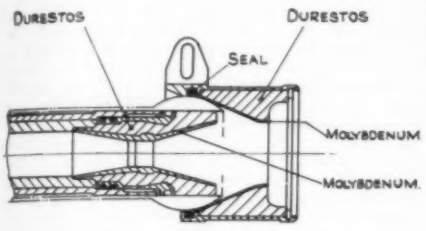
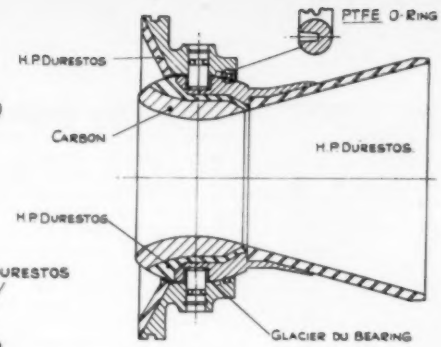


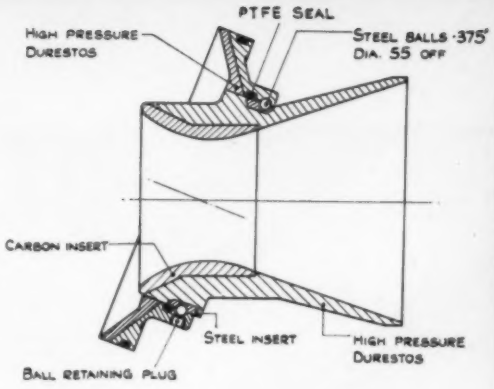
*Fig 4 Tubular-extension nozzle (below)*

*Fig 5 Ball/socket nozzle (right)*

*Fig 6 Rotating nozzle (far right)*




a torque of about 120lb-in. Larger motors require swivelling nozzles, and a ball/socket nozzle (Fig 5) uses a similar O-ring, sliding on a polished steel surface. At a pressure of 500lb/sq in, and thrust of 7,000lb, a maximum torque of 200lb-in is required to move the nozzle ±10° at 0.5c/s; aggregate weight of the assembly is 17lb. The final nozzle illustrated (Fig 6) has a rotating portion moulded in Durestos, with a steel insert acting as the inner race of an angular-contact ball bearing. This nozzle must be rotated ±30° to produce a deflection of ±10°, and at 0.5c/s a torque of some 1,500lb-in is required for a 7,000lb-thrust nozzle operating at 500lb/sq in. Total weight is 14lb. Extra weight for nozzles fitted to a light end-closure with four reinforced apertures would be about 8lb per nozzle for the ball/socket and 6lb for the rotating pattern. These figures must be increased by about 30 per cent for nozzles matched to vacuum operation.

### Dual-thrust Motors

The second paper from Summerfield, *Solid-Propellant Dual-Thrust Motors*, by H. M. Darwell, outlined the factors affecting the choice of propulsion system for missiles, many of which have lead to an infinite variety of dual-thrust systems. Broadly, dual-thrust motors can be grouped into four categories: single chamber, fixed nozzle; single chamber, variable nozzle; double chamber, single external nozzle; and tandem double chamber, with transfer tube from the forward chamber.

One of the neatest ways of changing combustion pressure is to employ a first-stage propellant separated from a second stage, with a different burning rate, by an interface corresponding to a burning surface. Motors of this type are essentially simple, having a single body and charge of conventional configuration and a single, fixed nozzle. Another solution is to introduce a change into the burning surface in a single propellant; but the fact that the motor has to burn at two widely different pressures can lead to excessive variation between one motor and the next. Combining the two methods can lead to a wide variety of motors with two different propellants with different burning rates and burning surfaces. At this point Mr Darwell included a plot of single-chamber firings, showing that thrust ratio, between 2 and about 8.4, was directly proportional to reduced pressure ratio. Specific impulses of such motors are currently about 150sec and there are indications that this level will in the near future be substantially increased.

Probably the ideal arrangement is to employ a single-chamber motor with a two-setting nozzle, throat area being decreased to correspond with the lower mass flow in the second stage of operation. So far no satisfactory design is known to have been evolved, but a promising arrangement involves an ejectable first-stage nozzle (Fig 7). The chief difficulties appear to be control of the rate of changeover and distortion due to heating.

Dual-chamber motors with a single external nozzle include an internal choke to raise the pressure in the forward chamber after consumption of the boost charge, and so allow the second-stage gases to pass at a reduced rate through the rear chamber and nozzle. Numerous experimental firings have confirmed the theoretical explanation of how such motors function. A major advantage of the arrangement is that there is no practical limit upon thrust ratio, and values as high as 50:1 have been achieved; but it is essential to insulate the rear chamber adequately, and at high thrust ratios the specific impulse from the second stage is poor at low altitudes. At present the most satisfactory means of obtaining thrust ratios greater than 8:1 at low altitudes is the double-chamber motor with a transfer tube [such as that illustrated in the drawing on page 85 of our July 15, 1960, issue—Ed]. Specific impulses of 150sec are being achieved.

In conclusion, Mr Darwell listed some of the actual motors developed at SRS. Models have been produced for anti-tank, surface-to-air and surface-to-surface bombardment weapons, having propellant weights from 4 to 2,200lb, diameters from 4 to 24in and thrust ratios up to 6:1. Flight trials of single-chamber, single-charge, fixed-nozzle motors are recording a specific impulse of 150. Flight trials are also in hand on a transfer-tube motor of 7.5in diameter, with a thrust ratio of 15:1; despite its small length/diameter ratio and intricate design, it is achieving a performance index in the region of 120.

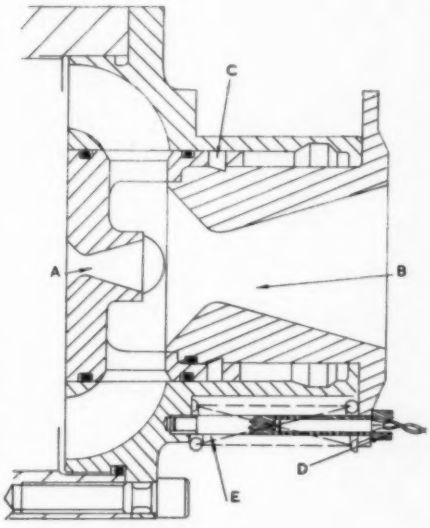



*Fig 7 A nozzle system (right) giving two levels of thrust; A, second-stage nozzle; B, first-stage nozzle; C, release pin; D, explosive charge; E, coil spring*

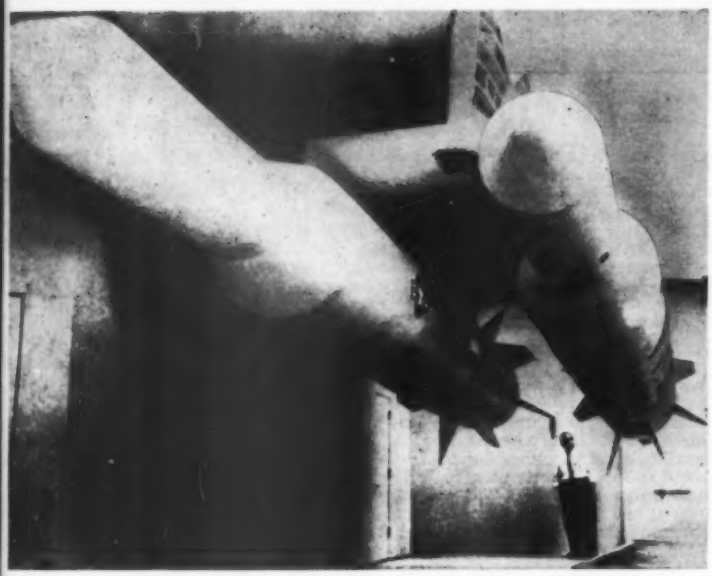
### NEW US NUCLEAR-ROCKET ESTABLISHMENT

A study of the requirements for a national nuclear rocket-engine development facility in the USA is to be made by a joint industry team, under contract to the National Aeronautics and Space Administration. The proposal which has been accepted was submitted by the Ralph M. Parsons Co in association with the Thiokol Chemical Corporation. In this, Thiokol is representing Talant, a team comprising Thiokol, the Allison Division of General Motors, Linde (a division of Union Carbide Corp) and Nuclear Development Corp of America.

The architectural and engineering study will be under the direction of the joint NASA/Atomic Energy Commission Nuclear Propulsion Office, which has the responsibility for developing nuclear propulsion systems for space vehicles. Factors involved will be site considerations, number and type of test stands needed, control centre, support facilities, assembly and disassembly buildings, water and electrical power requirements, construction costs and schedules.

### SOUTH AFRICAN RADIO TELESCOPE TAKES SHAPE

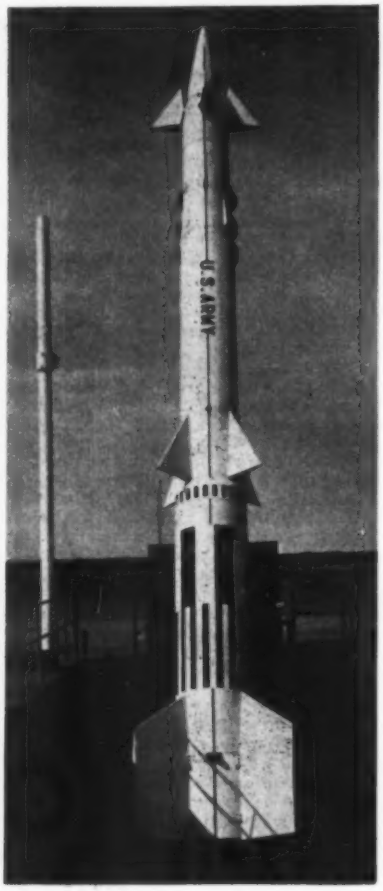
Erection of the 85ft diameter radio telescope located near Krugersdorp, South Africa, is due to begin this month. Site excavations began last November, and equipment was expected to begin to arrive from the USA in December. Under the agreement signed between the US National Aeronautics and Space Administration and the South African Council for Scientific and Industrial Research, the station will be operated and maintained by CSIR personnel. Total cost is quoted as between £1m and £2m.



*First illustration of the Skybolt air-launched ballistic missile, this photograph shows the engineering mock-up of the port installation of two missiles on the B-52H. It is discussed in the news-item above*

## Missiles and Spaceflight . . .

*Below, new photographs of US Army missiles. Recent Pershings (left) have an extended nosecone, while Nike-Zeus is depicted in firing position on its research and development launcher at White Sands*




### SKYBOLT SHAPE REVEALED

Reproduced at left is a photograph taken in Boeing's plant at Wichita, Kansas, showing the mock-up Skybolt installation beneath the port wing of the B-52H. Four dummy missiles were fitted beneath the first B-52H when it was rolled-out from the same factory on January 5 (photograph, page 41). Altogether, the twin installation represents a considerable aerodynamic and structural achievement. Vulcans will have single pylons.

Although Skybolt's general appearance was predictable, its detailed configuration has previously been closely guarded. In our special Missiles issue of November 4 last we published a provisional drawing, which can now be seen to have been a very near miss. The weapon does have aerodynamic tail fins, four of which are identical with the surfaces we predicted; but it also has four delta fins at the same body station. This is a most unusual aerodynamic configuration, and it is possible that four of these fins are fixed and the remainder movable control surfaces. It can also be seen that both stages of propulsion have the same diameter (like Polaris and Pershing), the re-entry vehicle being more slender. No jettisonable tail fairing can be seen on the mock-up. First-stage propulsion is not ignited until the missile has dropped well clear of the aircraft.

### DAVY CROCKETT UNMASKED

Photographs have been released showing the complete Davy Crockett tactical nuclear weapon of the US Army. As described in our May 20, 1960 issue, it is essentially a mortar firing a spin-stabilized rocket carrying a nuclear warhead; construction is largely of titanium, and both infantry and vehicle-borne versions are available. The photographs show the warhead to be of tear-drop form, about 9in diameter at its widest point, 30in long and equipped with four tail fins. The warhead is reported to be the same model as that used in the GAR-11 Falcon of the USAF, with a yield of about 1kT. Range is unofficially put at approximately three miles, yet it is said that no blast or fall-out can harm the troops using the weapon. Davy Crockett is likely to be the first nuclear device for forward troops of both the American and British Armies; and it is possible that the British examples will be manufactured entirely in the United Kingdom.

### EUROPEAN SPACE DISCUSSIONS: TWO-WAY EXCHANGE

Technical delegates from eight European countries and from Canada visited the United Kingdom this week to obtain information on Britain's proposals to develop a launch vehicle for scientific and commercial satellites together with European and Commonwealth countries. This is a preliminary to the forthcoming London conference at which government representatives will discuss these proposals.

On Monday and Tuesday, January 9 and 10, the overall plan was outlined and discussed at Church House, Westminster; on Wednesday the visitors were to go to de Havilland at Hatfield and Stevenage; and on Thursday a tour of the engine and test facilities at Spadeadam was planned. The European countries represented were Belgium, Denmark, West Germany, Italy, the Netherlands, Norway, Sweden and Switzerland.

Another visit this week was that of the Minister of Aviation, Mr Peter Thorneycroft, to Bonn, where he was to discuss with West German Ministers during January 10-12 the UK satellite-launcher proposals. Before returning to the United Kingdom Mr Thorneycroft was to visit Denmark, Norway and Sweden for further talks on the same subject.

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A test range for the transmission of messages by means of reflector-type satellites is to be established by Page Communications Engineers, a Northrop subsidiary. Test messages by voice and teletype will be transmitted between northern New York State and Trinidad.

Mr Overton Brooks, chairman of the US House of Representatives Space Committee, is urging President-elect Kennedy to "order immediate production" of Nike-Zeus. In the 1960 Fiscal Year, Congress appropriated $137m (£48m) to fund initial production, but the President withheld the money pending further demonstrations of feasibility.

On December 28 it was announced by the US Embassy in Rome that major units of a Terrier ship-to-air missile system had been delivered to the Italian naval yard at La Spezia. Supplied under the US military aid programme, the weapon system is being installed in the cruiser *Garibaldi*.

A contract to build three experimental satellite payloads which will supply supporting data for "future military space programs" has been awarded by the US Advanced Research Projects Agency to Convair-Astronautics. Under the project name Arents (ARPA Experimental Test Satellites), the contract is for $1.9m. Launchings will begin "early in 1962" in test flights of the Centaur vehicle.

A successful firing took place on January 7 from Cape Canaveral of a three-stage Blue Scout 1 carrying a 392lb scientific payload. Main test objective of the firing, carried out by the US Air Force, was to test the rocket itself, but the payload included scientific instruments to measure radiation in the lower edge of the Van Allen belt, count micrometeorite punctures and detect electrical signals above and below the ionosphere. The rocket's trajectory included an altitude of 1,000 miles and a down-range distance of 1,400 miles. Recovery of a 90lb instrumented capsule was attempted unsuccessfully.

# A GREAT DAY FOR THE IRISH

## *Boeing 720s on the North Atlantic*

"Flight" photograph

*Essential preliminary to Ireland's great day on December 14—the jet inaugural from Dublin to New York. Among the passengers were Irish Government officials and eleven lord mayors, mayors and lady mayoresses. Most of the British cities served by Aer Lingus were represented*

NOT without controversy, the transatlantic "Shamrock Jet" services of Aer Lingus-Irish International Airlines began on December 14. No one in contact with Aer Lingus this Christmastide could doubt that for the airline and for Ireland this first jet service is a considerable adventure, and that the first day of scheduled jet services was a great day for Ireland. But like most adventures, it has its risks and its challenges.

In the first place, Aer Lingus chose for their service the smallest of all the Boeing family—the basically medium-haul 720. And although additional wing bays were adapted to increase the total fuel capacity from 9,855 to 11,300 Imp gal (707-420 capacity by contrast is nearly 20,000 Imp gal) this Boeing, so the argument runs, is not an aeroplane with which the Atlantic can be flown non-stop all the year round, even from Shannon.

On the other hand, the 720 is the smallest-capacity Boeing by a margin probably sufficient to enable the frequency of services out of Dublin to be increased beyond those possible with a 707, a characteristic which should show to advantage in July and September when these aircraft are used three times daily on the route to London. The 720 is also appreciably faster than others of the family. Nowhere was this better demonstrated than in the early days of last month, when the Irish International 720-048 *Padraig* on delivery from New York to Shannon completed a Gander - Shannon route familiarization flight in 3hr 9min—a transatlantic record.

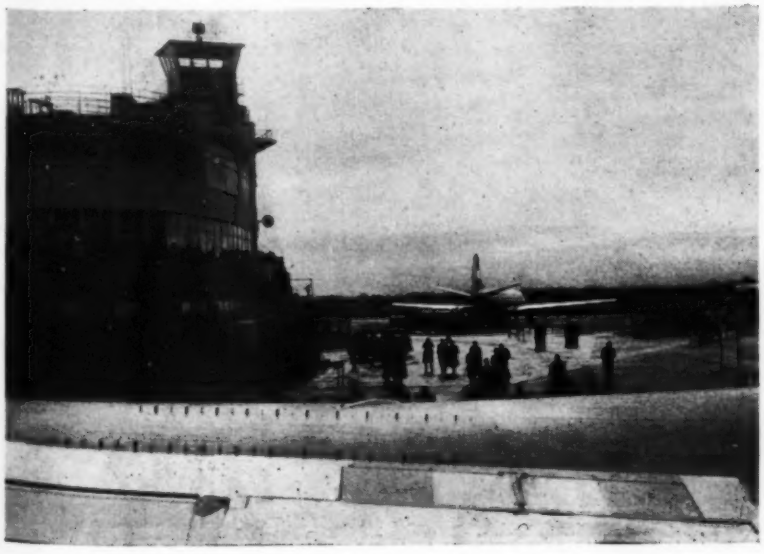
But winds of an average 85kt—a lesser order than those that made this eastbound time possible—caused the inaugural westbound flight on December 6 to put into Gander, a disappointing deviation for passengers who had hoped to make the journey from Dublin with only the routine stop at Shannon. Since average headwinds of this order are by no means uncommon on the North Atlantic during the winter months, when loads are high occasional refuelling stops in Newfoundland are presumably to be expected.

On the inaugural flight in which we recently participated, take-off weight for the Shannon - New York (eventually Shannon - Gander) sector was on the maximum 220,000lb, of which 90,000lb was fuel. At high-speed cruise this disappears at a steady rate of about 12,000lb/hr. Take-off performance is not particularly impressive at this weight—the JT3s have no water injection—and the run from standstill to lift-off took 48sec and covered 7,000ft.

On the Great Circle route to Gander we cruised at 35,000ft at maximum cruise thrust until the Machmeter crept slowly up past 0.8 to 0.87—faster than most of those on board had ever travelled before. The air was smooth, but the 720 never completely shed its tendency to roll—left and right it dipped its wing-tips through two or three degrees, twelve times or so a minute. A Boeing engineer explained later that the problem is not aerodynamic, but apparently hydromechanical, a function of power-boosting the rudder when the tall-fin modifications were introduced. For full-power boost, servo valves of much higher quality are needed than were required when only a yaw damper was fitted, and it must be that manufacture of the valve—or perhaps filtering of the fluid—on this particular aircraft was insufficiently accurate to prevent the rudder hunting. Other Boeings are rock-steady, but Dutch roll still makes an arbitrary reappearance on some of these aircraft.

To passengers, lulled perhaps by one of the most pleasant interiors yet to be seen in a Boeing, the roll is scarcely (and only visually) apparent. While the Aer Lingus 720 decor is not dissimilar to that of other 707 interiors, Walter Dorman Teague, the US colour consultants, have varied the seat colour every three rows from green to gold, and the walls are decorated with a mottled pattern "representative of an Irish stone wall." Another national touch appears in the partition between the first- and economy-class compartments, where "six square yards of Carrickmacross lace have been laminated in the plastic panels." Forward of this, and dividing the first-class "Golden Shamrock" compartment from the lounge, is a mural map of Ireland. First-class passengers are also discreetly reminded that an accompaniment to their meals is Irish glass and linen and that Irish food and drink figure on the menu.

A characteristic of the Aer Lingus



*Taken the moment before the door closed on the full load of passengers and crew on the inaugural flight, this photograph shows part of the large crowd of Dubliners who came to cheer the first Aer Lingus 720 "Padraig" (St Patrick) on its way*

"Flight" photograph

*"The walls are decorated with a mottled pattern representative of an Irish stone wall." The passengers are the Lord Mayor and Lady Mayoress of Bristol*

## A GREAT DAY FOR THE IRISH . . .

Boeing 720s is that the bulk of the 117 seats are economy-class, only 16 being available to first-class passengers. This configuration reflects the nature of the business for which the 720s have been purchased—the attraction of large numbers of American tourists to Ireland *en route* to other places in Europe. The airline is now well equipped to cater both for transatlantic travellers to Shannon and Dublin—for whom the fast 720s should have a special appeal—and for those travelling on from Dublin to various destinations in Europe. By the same token, the airline is actively campaigning for new first-class hotels in Ireland and for good conference facilities in Dublin as promotional aids for selling travel.

In his study *Irish Airlines*, the Irish economist Garret FitzGerald suggests that the Aer Lingus - Irish International transatlantic operation has advantages which make it unique among the North Atlantic jet coterie. In the first place, from Dublin the airline can offer a wider range of direct routings to places in Europe than can any other transatlantic airline. This derives from Ireland's position on the north-western edge of the European continent. Unlike other European airlines, which have their transatlantic termini further east, Aer Lingus has no occasion to "back haul" passengers from North America to their final destinations at the western edge of the European continent. Also, while the "beyond" rights to European countries of the two US transatlantic airlines are restricted, Aer Lingus "has a right of access to all of them and has exercised the right in nearly every case." At present only about ten per cent of American tourists *en route* to Europe stop-off in Ireland. Increasing that number is the *raison d'etre* of the jet fleet.

Another advantage claimed for the Irish airline in developing its transatlantic jet operation is its continued low level of overhead costs (see *Flight*, November 11 and 25, 1960) and the low operating costs per aircraft mile of the Boeing 720. By taking advantage of their favourable geographic position, Aer Lingus have been able to purchase for Atlantic operation the smallest, lightest and lowest-first-cost aircraft in the Boeing family.

But it is doubt about the wisdom of this action—the query that exists about the capability of the essentially medium-haul 720 as an Atlantic all-the-year-rounder—that has given rise to one of the controversies that surrounds this service. Against this must be set the advantage that in future years the company should gain from having available jets of a type suitable for service within Europe.

Another controversy concerns the speculative nature of Ireland's investment in a fleet of three aircraft, a further two of which have been placed on option. For a profitable return to be shown on this £6m purchase not only must traffic between North America and Ireland continue to increase, but Aer Lingus must wrest an increasingly greater share of it from its well-entrenched transatlantic competitors. It has also been queried in Ireland—not for the first time—if there are not more profitable and socially urgent lines of Government investment than in air transport.

In placing an order for three Boeing 720s for the Atlantic service the assumption was made that Aer Lingus transatlantic passenger traffic would rise from 13,380 in 1958-59 to 42,500 in 1961-62, the latter figure being that required for the jet service to break-even in its first full financial year. In the first year of operations (with Super Constellations chartered from Seaboard and Western) a better-than-forecast figure of 14,176 passengers was carried. The following year, however, when it was hoped that seats would be bought by 25,000 passengers, numbers travelling both by air and by sea fell off, partly owing to a decline in emigration to North America. This gave the airline cause for concern; total passengers carried during the year was about 21,500, so that the already substantial task for 1960-61 was increased.

It meant, in effect, that the estimate of 27,000 transatlantic passengers had to be revised to make up for the deficit of the previous year. The passenger increase required was about 40 per cent and in the summer of 1960 Aer Lingus - Irish International was the only remaining airline operating transatlantic scheduled services with piston-engined equipment.

Great efforts by the airline's commercial department resulted in 22,800 seats being sold in the first six months of the 1960-61 financial year, and there is a firm prospect of the target figure of 30,500 being reached over the twelve months. Against this background of achievement, the aim to increase passenger traffic by another 40 per cent in 1961-62 on the new jet routes between Ireland and New York and Boston does not appear impossible. Even so, the task is formidable.

Great strides have also to be made in freight uplift, since the Boeings have two-and-a-half times the freight capacity of the Super Constellations which they replace. (The contract with Seaboard ended at the end of the year.) Relatively little transatlantic freight originates in Ireland, and it is from England and from Continental sources that an increased force of Aer Lingus representatives are seeking fresh business for their westbound flights. A peculiar difficulty is that this freight has all to be trans-shipped at Shannon, a disadvantage that would be crippling were it not for the lack of Customs at this duty-free port.

In some countries the arrival of a new type of aircraft causes no more than a ripple of national interest, but enthusiasm for the first 720 has even surprised Aer Lingus. Any doubts that there may have been about the economic wisdom of Ireland's expensive purchase appear to have been dispelled by the aircraft's arrival; the subsequent inaugural flight was exuberant indeed.

This solid national support is greatly in Aer Lingus' favour, the present Prime Minister of Ireland, Mr Sean Lemass, having been godfather to the airline when he was Minister for Industry and Commerce; he has encouraged and nurtured it over the years.

Such an uplift to already good morale has been given by the Boeing service that the economic burden of its introduction cannot easily be weighed. The effort made last year has shown that the break-even traffic target is not so far out of reach as might be supposed; and if traffic can next year be increased to 50,000 passengers annually Aer Lingus should show an operating surplus. The problem is going to be for the airline to maintain its low cost-levels; if these are allowed to slip, that Atlantic break-even target could be very elusive.

A. T. P.

*To be delivered this month is the second of the 720 fleet "Brighid," seen here at Renton, Washington. The third aircraft will be delivered towards the end of February*

# Spot not on the map

You are unlikely to find Jiwani in your atlas. A small fishing village, it lies in rugged, waterless country on the coast of West Pakistan, 40 miles from the Iranian border and 350 air miles from Karachi. Roads are mere sand tracks and the only approach is by sea or air.

Air? Yes, Jiwani has an airfield. True, today's airliners seldom use it, except in emergency; but to smaller aircraft of limited range flying through to the Far East it is an essential staging point.

Life at the base is lonely and spartan. Water is rationed and food is sparse. Communications are poor. There is an irregular coastal launch service from Karachi and once a month a Dakota of Pakistan International Airlines flies in supplies and relief staff. Mail comes via Gwadur 65 miles away by runner or camel. How welcome are the visitors who land to fuel!

To keep Jiwani supplied with aviation fuel is far from easy. But Burmah-Shell takes care of that. Supplies are shipped from Karachi in "country craft" which are run aground at high tide and the drums off-loaded by plank ramps to the shore. The trip takes 8-10 days, but for 4 months the monsoon makes sailing well nigh impossible.

Shell aviation service operates in all kinds of places throughout the world, no matter how difficult they may be to supply . . . at famous international airports and at little-known airfields which, like Jiwani, serve Aviation in remote parts.

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# FLIGHT SYSTEM SURVEY

*International Telephone and Telegraph Corporation's proposal for a three-dimensional display for tracking aircraft, missiles, satellites or submarines. Flashing pinpoints of light are projected into the screen, which rotates rapidly; and the traces can be seen from all round and appear to move through the display*

## Eurocontrol Planning Body and Council

AT a first meeting in Paris on December 20, the officers of the directorate of planning of Eurocontrol were elected, as follows: chairman, Pierre Nottet, director-general of the Belgian Civil Aviation Administration; vice-chairman, Commodore J. W. Thijssen, deputy chief of the Netherlands Air Staff; secretary, Pierre Hamer, head of civil aviation in Luxemburg. The purpose of the directorate is to evaluate systems and procedures in readiness for the ratification of the convention by the participating nations, and will form the nucleus of the headquarters to be set up later in Brussels.

A council was elected at the same meeting to form the basis of the experimental establishment to be set up later near Paris. Pierre Nottet was again elected chairman, with Maj Alfred Mieth, head of the West German military air traffic services, as vice-chairman. Treasurer is Gp Capt J. Veal, Director-General, Aviation Navigational Services in the MoA; and secretary is L. Lansalot-Basou, chief engineer of the air navigation department of the French secretariat-general for civil aviation. The council appointed René Bulin, head of the French SGAC air navigation department, to be director; and G. Broadbent, MoA deputy director (technical), and Fritz Hentschel, director of traffic control in the German Ministry of Transport, to be deputy directors. An assistant director is to be appointed later.

## More Airways Radar in US

A CONTRACT worth $5.2m has been placed by the Federal Aviation Agency with Raytheon Co for additional ARSR-2 surveillance radars. This will bring the number of Raytheon radars covering the US airways to 52. Twelve military defence radars are also used for traffic control.

The use of power tubes called amplitrons has increased range to 200 miles on transport aircraft and height cover to 60,000ft at shorter ranges. Circular polarization eliminates rain clutter and an improved MTI and video map systems are incorporated. The new aerial measures 25ft × 50ft, instead of 11ft × 40ft, and gives better high-altitude cover at short ranges. The first of the ARSR-2s is to be delivered in January next year, but the sites have yet to be determined. Signals will be brought to the traffic control centres by microwave link.

## 1961 Hopes for Electronics

THE chairman of the Electronic Engineering Association, Mr L. T. Hinton, stated in a New Year message that "in the face of severe and growing competition from other countries, exports of electronic equipment held steady at the 1959 record level; the Autoland system for aircraft was a major technical breakthrough, making for increased safety, while the labour figure in September (1960) showed an increase of five-and-a-half per cent over the corresponding figure a year previously. The cutting of the guided weapons programme, the Outer Seven/Inner Six controversy, and the lack of stability in hire purchase and purchase-tax policy may all have been frustrating, annoying and harmful to some degree, but I am sure that electronics—a vigorous and ever-growing industry—will shake off these troubles, and in 1961 will go even faster and further."

## CSF Radar for Australia

TWO terminal radars with 4MW power and 150 miles' range have been ordered by the Australian Department of Civil Aviation from the French CSF company. They are to be installed at Sydney, which handles all jet airline traffic coming to Australia, and at Adelaide, where a civil/military traffic problem is growing up because of the proximity of Woomera. The radars are to be delivered during next year. Further units may be ordered for airports at Melbourne, Brisbane and Perth. This is the first major aviation electronics order to be obtained in Australia by a French company. Considerable efforts are being made to obtain further orders, one example being the Cyrano fire-control for the Mirage. Cyrano is, of course, in competition with the Ferranti Airpass 2.

## Collision Avoidance "Some Years Off"

IN an end-of-the-year statement, the Federal Aviation Agency lists some of the projects at present in hand, giving in particular some information on collision avoidance systems now under study. James L. Anast, director of the FAA's research and development bureau, reported that while projects now under way have shown "somewhat promising" results, the problems still to be solved are such that "the availability of a successful airborne collision prevention system cannot be foreseen for a few years yet." The most efficient means of providing safe separation between aircraft was still effective and reliable ATC.

Three kinds of anti-collision system are being sought—collision avoidance systems giving full protection; pilot warning instruments; and conspicuity enhancement. Work on the Bendix co-operative CAS, using range and height information only derived from differentiation of direct ground-reflected transmissions, coded for height, has confirmed predicted capability of the ranging technique. This system was first described in *Flight* for February 27, 1959. A preliminary flight in December showed that threat prediction was possible and equipment is now being delivered to the FAA experimental centre for further trials. Collision avoidance with the Bendix system would be by changing height rather than course.

A flush aerial is being tested for suitability in collision-avoidance systems and simulator studies are under way to assess pilot performance and capability in see-and-be-seen flight. It has been found that the red-light beacons generally carried by aircraft perform very efficiently as infra-red beacons and it is thought that an infra-red proximity detector could be made cheaply, and light enough, to be fitted even to light aircraft.

In other fields, the FAA is still testing the first units of the Data Processing Central and several kinds of automatic ground-air-ground communications are being evaluated. Automatic acquisition of flight information by three-dimensional radar, radar beaconry and telemetering techniques is being investigated.

Work is also under way to determine the feasibility of simultaneous ILS approaches to parallel runways in an effort to increase the capacity of airports.

## E.M.I. and Traffic Control

A SEMI-AUTOMATIC traffic control system based on an Emidec 2400 computer as information centre and master control is under development by E.M.I. Electronics Ltd. The computer can accept flight-plan information and plot the progress of an aircraft, using data stored in its memory. Radar information can also be fed into the computer and automatic warning of traffic conflicts or other essential information can be produced.

This is one of the E.M.I. projects which will come within the province of AVM W. E. Oulton, who has retired after 32 years' service with the RAF and joined the company as director responsible for Ministry work. AVM Oulton helped set up the London air traffic control zone in 1946, was the first RAF director of the Joint Anti-Submarine School at Londonderry and was task-force commander for Operation Grapple, the nuclear-weapon tests.

## Computer-controlled Production

BELL Helicopter Co is well advanced in converting its entire factory management to computer control, using an IBM 650 data processer. They have already saved 50 per cent lead-time and $500,000 in stores buildings.

The computer controls buying, receiving, storing, production, despatch, billing and manufacturing accounting and issues exception reports whenever management action is required. Contractual, materials, labour, tooling, purchasing, factory and routing information is stored on memory drums and tapes. A master tooling file lists tools to be used in production of specific parts and reports the current location of the tools. The computer calculates the time required for each manufacturing operation and produces written instructions for the complete production schedule for each helicopter. Bell have now ordered a faster IBM 1401 data-processing system to speed up the operation.

# ROTATING-WING SAILORS

## *Training RN Helicopter Pilots*

BY HUMPHREY WYNN

MORE and more emphasis has been placed by the Royal Navy in recent years on the employment of helicopters. Their use for planeguard duties, when deck landings and take-offs are in progress, has long been established; and they supply a quick means of physical communication between ship and shore. These roles have been supplemented lately by functions which give rotating-wing aircraft an operational capability, as anti-submarine weapons and as vehicles for Commando troops.

The strategic background for these new employments is well known: on the one hand the ever-increasing Soviet underwater fleet; on the other, the risk of limited wars, which can be contained by prompt action. Helicopters have been found to be efficient submarine hunters, and the Royal Navy has several squadrons for this purpose, at present equipped with Westland Whirlwind HAS.7s. These aircraft are to be replaced by the turbine-powered Westland Wessex, which has the ability both to seek out submarines and to destroy them, and is at present being proved for squadron service (*Flight*, November 11, 1960); and by the small P.531, the Saunders-Roe helicopter capable of operating from ships other than carriers. The other role, that of conveying troops quickly to trouble spots, is being performed by Whirlwinds on Commando carriers. The first of these carriers, HMS *Bulwark*, has been in service since January 1960; and a second, *Albion*, is currently being converted for the same purpose. It is expected that the Wessex, with its greater carrying capacity, will eventually replace the Whirlwind in the Commando role.

This increasing use of helicopters means that the Royal Navy must have a greater supply of rotating-wing pilots. In March 1959 it was announced that a new five-year short-service commission was being introduced for pilots trained specifically for helicopter duties.

Under this scheme, young men between the ages of 17 and 26 are accepted for training provided they possess a GCE educational qualification and have passed a flying aptitude test, interview and medical examination. They then go to the RN College at Dartmouth for two terms, for preliminary Naval training, as cadets.

Flying begins for the five-year men at RAF Linton-on-Ouse, Yorks, where they take a 28 weeks' course on fixed-wing aircraft at No 1 Flying Training School. Provided they complete this successfully they move south from Yorkshire to Cornwall, to

*On the opposite page a Whirlwind and Dragonfly of No 705 Sqn are seen over the Cornish coast near RNAS Culdrose*
"Flight" photograph

*At right, one of the squadron's Hiller HTE-2s, with the writer aboard as pupil and Lt J. de B. Wailes as instructor, departs on an ab initio training sortie*
"Flight" photograph

*Below, HRH Prince Chula of Thailand presenting flying badges at Culdrose to two members of the HSP course which passed out last month. Behind the prince are Capt C. L. F. Webb, captain of HMS "Sea Hawk" (RNAS Culdrose), and Lt Cdr R. G. D. Williams, who commands 705 Sqn*

RNAS Culdrose—commanded by Capt C. L. F. Webb, DSC, RN—to begin their helicopter training.

Culdrose airfield is just south of Helston, the Cornish town famous for its flora or "furry" dance, some eight miles north of the Lizard. To the west lie Mounts Bay, with St Michael's Mount its dominating feature, and Penzance. The Royal Naval Air Station has many activities: it is the home base of 849 Squadron (Gannet AEW.3s), the present location of 700H Sqn Wessex Flight, headquarters of the School of Aircraft Handling and the Aerial Torpedo Development Unit, and centre for basic Naval helicopter training. This last function is handled by 705 Sqn, and it is to this unit that the five-year commission trainees come for their first experience of rotating-wing aircraft.

The squadron, which is commanded by Lt Cdr David Williams, trains not only helicopter specialist pilots (as the 5-year men are called) but also General List and supplementary officers. Thus in addition to the HSP courses there is also a helicopter conversion course for already qualified fixed-wing pilots, and Naval airmen are trained for aircrew duties such as winchmen.

The unit's full title is 705 Sqn Royal Naval Helicopter School, and it proudly claims to be the first training establishment of its kind in the world. Its flying instructional staff are all graduates of the RAF Central Flying School and the squadron is equipped with Hillers, Whirlwinds and Dragonflies.

At the school, the five-year pilots take a course lasting 21 weeks (including leave), during which they do a minimum of 85hr flying. Their initial taste of helicopters is acquired on the Hiller HTE-2, and in the first five weeks they have 30hr experience on this type. Training for the remaining 13 weeks is carried out on Whirlwinds, the HSP course members doing 55hr flying on these aircraft.

Concurrently there are lectures on ground subjects—aerodynamics, airmanship, navigation, meteorology, communications, ship and aircraft recognition, air medicine and safety equipment—and also on the Royal Navy, the latter given by the Commander, Cdr P. W. A. O'Rorke, DSC, RN. The chief ground instructor and HSP course instructor is Lt Cdr D. F. Burke, and some of the instructors combine other posts on the station with their teaching duties. For example the met officer, who lectures in meteorology, is also an education officer.

Examinations taken by the courses are set and marked by an external body, under the authority of the Flag Officer Air (Home). Success on the course depends upon proficiency in ground subjects as well as aptitude in flying.

When the flying instructors who have passed out from the CFS at RAF South Cerney are posted to 705 Sqn as QFIs, they don't instruct in the Hiller Stage of training for about three months. This is so that indoctrination of beginners is the responsibility of the more experienced staff. It also gives the new instructor time to practise in and be standardized on the Hiller.

On a recent visit which *Flight* made to Culdrose the writer, a fixed-wing (wartime-trained) pilot, had an opportunity of flying a helicopter for the first time when he was given an *ab initio* sortie by one of the instructors, Lt Jeremy de B. Wailes, in a Hiller HTE-2. This is a very simple type of machine, ideal for such training, with basic flying instruments and dual controls. For this experience, the writer sat in the middle of the cockpit (which is wide enough to seat three people on a bench-type seat), with the instructor on his left. Throat microphones were worn, because of no oxygen masks being needed, and bone domes. In other respects, the equipment used, and strapping-in procedure, were as simple as for a Tiger Moth.

Starting the engine and rotation of the blades were almost simultaneous, and as the aircraft had only just landed from a training sortie there was no need for warm-up. When airborne we paused for a few minutes above the tarmac for the benefit of *Flight's* photographer, then moved away from the airfield boundary to be clear of other aircraft. In this demonstration, as Lt Wailes put it, we compressed the first half-dozen exercises a Naval pupil receives. The writer was shown hovering, auto-rotation and landing.

The Hiller has dual cyclic sticks and collective-pitch levers, and in my position I had the instrument console (which is central) immediately in front of me. The cyclic stick was between my knees and the collective pitch, which has a twist-grip throttle, at my left hand. There is excellent visibility forwards, downwards and sideways, and at low level a quite vivid impression of speed. This type of flying is probably the nearest present-day approximation to what the earliest aviators felt, sitting out at the front of their slow machines, though nowadays one enjoys a great deal more comfort and protection.

The greatest difficulty I felt was in adjusting myself to new types of control movement, and in co-ordinating use of the throttle, collective-pitch and cyclic stick and rudders. One has to learn to think of four things at once, though this is no harder than learning to drive a car, when co-ordination of accelerator, clutch, steering-wheel and brake have to be indoctrinated. When we were hovering, I found that the wind was blowing us to port; this was corrected by moving the cyclic pitch to the right, so that the "tilting" of the rotor disc counteracted drift. When we wished

## ROTATING-WING SAILORS . . .

*The Commander, Cdr P. W. A. O'Rorke, lecturing to HSP course students*

to move forward from the hover, I was instructed to move the cyclic pitch forward, with the result that we sped on our way in what felt to be a nose-down attitude. Conversely, to bring the aircraft to a hover, the pupil is instructed to move the cyclic stick back, rather as if reining-in a horse.

Autorotation involves a pretty rapid rate of descent, like a high-speed lift; it is essential to learn this early in training as it is a necessary emergency procedure in the event of engine failure. The all-important part of autorotation drill is to check the aircraft's descent at exactly the right height above the ground. (Shortly before *Flight's* visit to Culdrose, one of the 700H Sqn pilots had made a successful autorotational landing with a Wessex in a field near the aerodrome). Normal powered landings are taught before autorotation; but once the new helicopter pilot has mastered basic autorotations he should be fit for his first solo flights, the emergency procedure giving him confidence in the same way as aerobatics and stalling give confidence to a fixed-wing pilot in handling his machine.

Our flight lasted only 20 minutes, but was long enough to give me an appetizing first taste of helicopter flying. By the time the HSP course members have done 30hr on the Hiller, they should know whether they like rotating-wing flying or not, and their instructors know whether they have a real aptitude for it. When they have gone on to Whirlwinds and completed 85hr flying, as well as reaching the necessary standard in ground subjects, the new Naval helicopter pilots receive flying badges at Culdrose. Then the operational aspect of their training starts, when they go on to HMS *Osprey* at Portland, Dorset, for instruction in anti-submarine duties. But that is another story.

## FIGHTER COMMAND DEPLOYMENT

FOLLOWING the announcement that Fighter Command is to come under the orders of the Supreme Allied Commander Europe (*Flight*, December 30), a Ministry of Defence spokesman has said that Britain's fighter aircraft could not be deployed without the Government's approval.

The Government would still be able to deploy Fighter Command aircraft as they thought fit, but there was an obligation to inform SACEUR of the deployment decided on. There was "no change whatever" in the operational role of Fighter Command. If it were decided to make changes in size and composition—for instance, to alter the ratio of manned aircraft to missiles—this could be done, but SACEUR would be consulted.

## V-BOMBER EJECTION

IT has been decided not to instal ejection seats in V-force aircraft of Bomber Command for crew members other than the two pilots, who have always had this amenity. A recent Air Ministry statement says: "In view of the experience and the low accident-rate over the five years that the V-bombers have been in RAF service and of the considerable time, effort, disruption and cost which would be involved in modifying the aircraft, it has been decided that the provision of ejection seats for rear-crew members cannot be justified."

In the light of this decision, it is interesting to record that on July 1 last year a successful live ejection from a rearward-facing seat in a Valiant was carried out over the Martin-Baker test airfield at Chalgrove, Oxon. The ejectee was Mr W. T. H. Hay, who came out of the aircraft when it was doing 250kt at 1,000ft. Martin-Baker say that "as far as is known, this was the first rearward-facing live ejection in the world and it fully proved the feasibility of such ejections. The physiological and engineering problems are little different from those connected with the normal forward-facing seats and the same principles can be applied to overcome these problems."

## TAKING A JOKE

EIGHT exciting minutes in the life of a Fleet Air Arm observer are recorded by Lt J. S. Sturgeon in the latest *Martin-Baker Review*. He tells how on a catapult launch from HMS *Albion* off Gibraltar the Sea Venom of 894 Sqn in which he was flying suffered engine failure; how he ejected below flight-deck level, about 30ft above the water and at an estimated airspeed of 120kt; and how, in the sea, he was horrified to find the great vessel bearing down on him.

"The captain, however, with a fine example of seamanship, managed to swing the carrier away from me and the ship went crashing past. I could clearly see all the flight deck crews and other spectators before the bow waves hit me. Then the ship had passed and there was the blessed planeguard helicopter to pick me up. The crewman had to cut me out of the parachute before I could get into the cabin, but we managed it somehow and I was deposited back on board approximately eight minutes after I had first left it."

Sturgeon's pilot was still in the aircraft when it hit the water and disintegrated on impact; he suffered severe injuries but made a good recovery and is now flying again. The film normally made of all carrier launches and landings showed that the Sea Venom's total flying time was about ten seconds. Sturgeon himself records laconically that he was passed fit and included in the afternoon's flying programme, adding the comment: "There is an old Naval saying—'If you can't take a joke you shouldn't have joined.'"

## FRIENDSHIP IN MINIATURE

THE latest 1/72nd scale model-aircraft kit from Airfix Products Ltd is for the Dutch-built version of the Fokker F.27 Friendship in Aer Lingus colours. Based on EI-AKA, one of the fleet, it includes two usual refinements of these realistic little moulded-plastic models—a retracting undercarriage and control surfaces.

The kit is not a difficult one to assemble (writes an enthusiastic young model-maker on *Flight's* staff), but care should be taken with some parts, such as the undercarriage. Points that might have been rectified are (a) that the transfer sheet should include the name of the aircraft, as found throughout the Aer Lingus fleet, and the Irish national emblem for the fin flash; and (b) that the tailplane tabs should be shortened in order to fit flush into the slots provided.

### FORTHCOMING EVENTS

Jan. 13. RAeS Rotorcraft Section: a.g.m. and "Certification of Civil Transport Rotorcraft with Particular Reference to Multi-engines," by H. E. Le Sueur.

Jan. 13. Society of Instrument Technology (Midland Section): "Controls Associated with Flying," by Capt A. M. A. Maiendie.

Jan. 16-20. Institute of Physics and The Physical Society: Annual Exhibition (Jan. 19—Lecture: "Some Physical Problems in Travelling at Supersonic Speed," by Dr F. P. Bowden).

Jan. 18. RAeS Agricultural Aviation Group: "Locust Control from the Air," by Dr R. C. Rainey.

Jan. 18. BritIRE (Merseyside Section): "Microminiaturization," by H. G. Manfield.

Jan. 19. RAeS (main lecture at Southampton Branch): "Trends in Aircraft Propulsion," by H. Pearson.

Jan. 20. RAeS Man-powered Aircraft Group: "Gliding and Man-powered Flight," by Lorne Welch.

Jan. 20. Institute of Navigation: "Presentation of Height Information in Aircraft," by A. Stratton and K. R. Honick.

Jan. 21. Society of Environmental Engineers: Discussion on "Development of Accelerated Climatic Tests."

Jan. 24. RAeS: "Problems of Erosion and Impact," by Dr R. N. C. Strain.

Jan. 24. Society of Instrument Technology (Tees-side Section): "The Experimental Investigation of Space," by Dr P. J. Bowen.

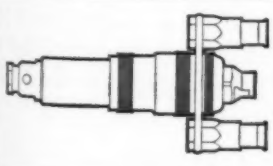
Jan. 25. BritIRE (Electro-Acoustics Group): "Noise Correlation Measurements," by K. R. McLachlan.

RAeS Branch Fixtures (to Jan. 20): Jan. 16, *Boscombe Down*, "Human Elements of High-speed Flight," by J. E. Gabb; *Henlow*, "Development of the Spectre," by W. Neat. Jan. 18. *Bristol*, "Man-powered Flight," by T. R. F. Nonweiler; *Brough*, "The Beverley in Service" (young people's lecture), by Gp Capt F. C. Griffiths; *Coventry*, "Supersonic Transports," by R. G. Thorne; *Manchester*, "Airline Engineering," by Capt P. McCormack. Jan. 19, *Southampton*, main lecture (see above). Jan. 20, *Hatfield*, Social.

# up desoutter

THE MANAGING DIRECTOR is most excited about all this Rockets-to-the-Moon business. With reason! Millions of holes in these are being drilled by Desoutter Drills and filled by Desoutter Screwdrivers and Nut Runners. He says any moment these Rockets will be swooshing off with men aboard (and he hopes Ladies too and a Small but well-stocked Bar) to all parts of the Universe. He says he will gladly be a passenger on any of them with a slight leaning towards Venus.

*("The old goat!" muttered a faithful employee).*



*The P.56M Rivet Miller is used by English Electric Aviation Ltd. in the manufacture of the Thunderbird.*

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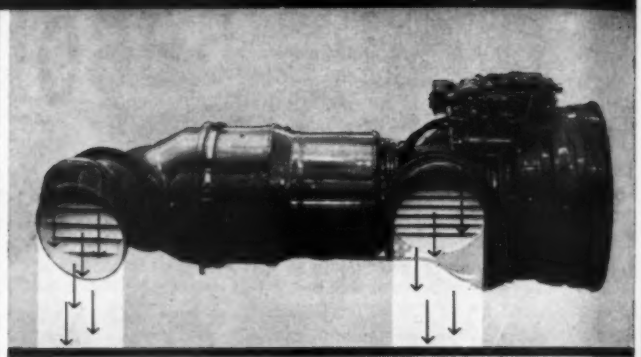
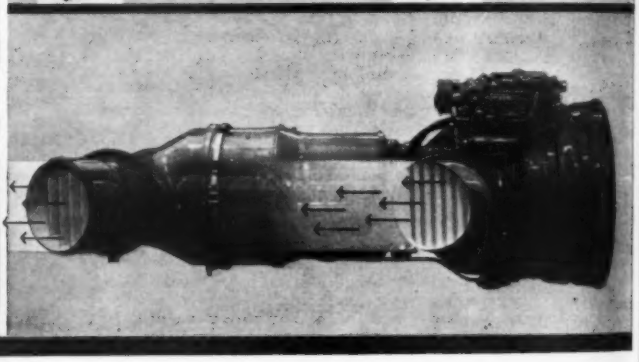
# LIFT and THRUST from ONE ENGINE— the Revolutionary BS 53 Turbofan





## ...ANOTHER ENGINEERING ADVANCE BY BRISTOL SIDDELEY

The new Bristol Siddeley BS 53 high-ratio turbofan represents a major engineering breakthrough in the field of aircraft propulsion. Because the BS 53 can be fitted with movable nozzles evenly disposed around the centre of gravity which give directional control to its total thrust, this remarkably versatile engine provides the airframe designer with a *single power source for all conditions of flight.*

**VTOL, STOL and normal take-off capability in the same aircraft. Suitable for subsonic or supersonic applications.**

**High cold-flow ratio gives high thrust for low weight, low fuel consumption and low noise level.**

**Conventional installation. Operational simplicity. Independent of all fixed ground installations.**

**Problems of ground erosion, recirculation and ingestion of debris reduced to a minimum.**

The Bristol Siddeley BS 53 has already been selected for, and is now undergoing trials in, the Hawker P 1127 VTOL light strike fighter and is supported by the Mutual Weapons Development Programme for NATO.

BRISTOL SIDDELEY ENGINES LIMITED

# JP.4: An Airline Replies

## TRANS-CANADA AIR LINES' CASE FOR THE SAFETY OF WIDE-CUT GASOLINE FUELS

**THROUGHOUT the controversy about the relative safety of kerosine and JP.4, no user of the latter has stated his case. This article, first drafted by TCA last November, offers the views of a highly respected operator which, since it became the first to introduce turbine aircraft in North America six years ago, has always used JP.4 in preference to kerosine. TCA's three turbine-fleet types are illustrated above.**

ONE cannot help but admire the sincerity, the ingenuity and the determination of the anti-JP.4 proponents, but such traits in a person do not necessarily make him right. It takes right thinking to be right. We forget that there are always three sides to every question—our side, the other fellow's side, and the truth.

The major difference between people is that some have never learned to think carefully before expressing an opinion. They fail to investigate and determine the real problem in its entirety, to observe scientifically, to check the validity and relative importance of their observations, to analyse the situation, and *only then* to draw conclusions.

A good airline engineer will always attack any major problem involving his company in a thoroughly unbiased and scientific manner before reaching his conclusions. We know of no major airline management that will then overrule the technical recommendations of its engineers where safety is involved.

In the case in point—kerosine *versus* JP.4—an engineering team (of men considered throughout the industry to be as good as they come in their specialized fields) studied the pros and cons of the two fuels for a year before finally recommending the use of JP.4 by TCA in its Viscounts for service early in 1955. At the time this recommendation was made, the airline had been told by its fuel-company representative that JP.4 would cost more than kerosine, so the recommendation was made to use JP.4 purely from an overall safety standpoint, and against the economic interests of the airline.

At that time there was no doubt in the minds of the team that kerosine was superior to JP.4 in certain circumstances, particularly under the condition of one type of accident (seemingly being stressed by the proponents of kerosine as if it were the only condition involving safety). However, the engineering team concluded that it would be safer to live with the devil they knew on the ground rather than with those they might not be able to always tie down in many more circumstances during flight.

Since that period the industry has come a long way in its knowledge of turbine fuels and in airframe and engine design to avoid troubles. For instance, in 1954 the British industry believed that the kerosine it had been using was satisfactory. TCA said it would not be acceptable with its −40° freezing point. Time has proved that at −40° freezing-point kerosine is not adequate for jet transports. Many of the fears associated with the use of kerosine that were justified at that time have been eliminated by the engine and airframe designers. There are still some unknowns, such as hazards associated with static electricity; but, of more importance, JP.4 still offers enough advantages from the overall standpoint of safety and reliability to outweigh the advantages of kerosine in one particular set of circumstances.

In our opinion, kerosine offers a greater possibility of trouble caused by failure of the human element. In this particular situation JP.4 is still a step ahead in safety over the aviation gasoline that has always been used since the beginning of flight. Would the anti-JP.4 brigade ban all flying in the world unless kerosine were used exclusively? If the standard of safety that has been achieved when using aviation gasoline is acceptable to the travelling public (which seemingly it has been) surely it is satisfactory to use JP.4, particularly since many experts consider it as safe as, or safer than, kerosine from an overall standpoint of safety and reliability?

At the present time we believe that *either* fuel can be used, because the airlines work on the premise that *no* fuel is safe. We have established our procedures and designs on the fact that any fuel *can* be as hazardous as any other under circumstances that can occur at any time. We believe that the fuel that will eventually be adopted by the airlines will actually be a new type lying between the present kerosine and JP.4. Since it will still be designed to burn in an engine when mixed with air in the right proportion and exposed to a source of ignition, it will still be susceptible to burning outside the engine should it encounter the right conditions. We shall continue to do our utmost to prevent these conditions arising. The airlines have always stressed that top priority in design and operating procedures goes towards preventing accidents in the first place.

It costs each of the major operators thousands of dollars daily to enhance safety beyond anything made mandatory through government regulations. One small example: no international regulation compels the big jets on the North Atlantic services to carry life-rafts; but all these aircraft carry them in spite of the probability of their emergency use being mathematically negligible. Commercial aircraft are fully licensed as airworthy when delivered, yet airlines make hundreds of modifications yearly to improve safety. For every new modification that is of a mandatory nature there are ten that are made simply because the airlines are always striving to improve safety and reliability. It would not be consistent, therefore, for the airlines to devote so much concentration in time and money to improving their safety records and at the same time not to give full consideration to something as simple as comparing different types of fuel from an overall safety and reliability standpoint.

Everyone realizes that there is no end to the things that could be done to improve safety. If all the ideas offered were used, aeroplanes would achieve the ultimate in safety—because they would not fly. The purpose of aviation is to carry people and goods between places more quickly than other forms of transportation, with an acceptable record of safety. In considering safety features one eye must be kept on the goal of providing a service to the travelling public at the cost that they can afford. The traveller also wants reliability. Each airline is therefore constantly striving to improve safety, speed, reliability, comfort and economy; and the industry has continually moved ahead, step by step, first in one field then in another. No airline can afford suddenly to become enthusiastic about one item, whether it be a safety feature or another, without stopping to reconsider the effect of the proposal on all the other factors.

## JP.4: An Airline Replies . . .

In 1955 TCA considered that it had achieved a big gain in reliability and comfort by switching its shorter-range services to turbine power. An investigation led to the belief that the airline would have jeopardized its gain in safety and reliability if it used the kerosine available in Canada at that time. This decision was made with the full knowledge of the arguments being put forward by the proponents of kerosine in 1954. TCA now believes its operating reliability and safety record with its Viscount services over the past six years have demonstrated better than words the soundness of its decision.

The same engineers reviewed the situation when TCA was purchasing its DC-8s and Vanguards and, after considering all the factors involved in operating an airline, concluded that they should again recommend that TCA adopt JP.4 as its standard fuel; but this time they agreed that kerosine *could* be used if and when there would be an economic advantage in doing so.

It must not be overlooked that kerosine is not subject to tax in Great Britain or the United States, so the use of this fuel when operating in these countries offers a considerable economic advantage. Because many of the airlines now believe there is little to choose between the two fuels from an overall safety standpoint, they rightly use whichever fuel is the cheaper, since this is to the advantage of their customers. In Canada it does not matter which fuel is used in an aeroplane—both are taxed equally.

It is futile to debate the technical characteristics of kerosine and JP.4, because invariably both sides believe they are right; one side may quote officially figures for fuel characteristics, and the other side can rightly counter that the laboratory tests on which the figures are based do not resemble conditions actually encountered in service. One side can perform a spectacular stunt like throwing a match in pools of the two fuels to demonstrate the difference in flame-spread and appeal to the emotions of the observers; the other side could spill the fuels on a piece of hot metal from a damaged engine and see one ignite at a much lower temperature than the other.

One can see moving pictures of both fuels igniting with their flame spreading at the same speed in an accident, or one can "rig" an accident with just the right amount of impact to demonstrate that one fuel is better than another. One can say that accident X would have been catastrophic had the "wrong" fuel been used; and the other side can demonstrate that the "wrong" fuel was used in accident Y, where it spread all over the ground from burst tanks and there was no fire. They can also supplement their viewpoint by quoting catastrophic fires that have occurred in accidents in which the "right" fuel was used. These types of arguments and statements can all be considered most questionable and each side can accuse the other of bias. With respect to crash safety, TCA would sooner rely on the conclusions of the extensive NACA crash-fire programme, which demonstrated scientifically that enhanced crash-safety cannot be achieved through choice of fuel.

### Oil Company's Conclusion

Telling evidence is provided by a confidential bulletin issued by one of the world's major oil companies to its marketers. This oil company sells both fuels, so is not interested in either side being right or wrong. The bulletin reviews the whole situation, and its conclusion is well worth quoting, together with some of the points leading up to that expression of opinion:—

> "It appears that there is no evidence that one type of fuel has any over-all safety advantage. The soundest position to take is to acknowledge that all fuels are hazardous and should be treated identically. The final choice is the airlines'."

Among the points brought out in this bulletin is the fact that turbo-fuel quality requirements have become much more stringent with respect to freezing point, smoke point, thermal stability, gum content, percentage of aromatics, and other characteristics since kerosine was used in the first turbine engine. It is mentioned that as fuel volatility increases (i.e., towards JP.4 rather than towards kerosine) reliability of ignition improves, carbon deposits decrease, flame-out tendencies lessen, smoke generation decreases (which can be important at airports during smog conditions), combustion efficiency increases, and temperature of engine parts decreases (which means increased parts-life as the flame radiation decreases). Also cited is better pumpability at low temperatures, improving starting in very cold conditions.

It can also be added that the higher BThU/lb of JP.4 gives more range for the same payload. In this regard it might be remembered that 1 per cent in fuel weight on one of the big jets is equivalent to seven passengers. This saving in weight is important from a safety standpoint wherever take-off weights are limited because of runway lengths, altitude, temperature or airport regulations. The only time kerosine's higher BThU *per gallon* (i.e., in volume as distinct from weight) is of benefit is when tanks are completely filled; this occurs on a very small percentage of trips if the correct aircraft has been selected for the route.

Because of their higher viscosity, turbine fuels of the kerosine type can carry more dissolved and entrained water than can the gasoline-type fuels. At low temperatures this can result in ice-blocked fuel filters and engine starvation if a deficiency or an incorrect setting occurs in the pressure or thermostatic control of the fuel-filter heater.

It is easier to control cleanliness in JP.4, because its lower density and viscosity result in faster settling times for dirt and water. The lower boiling range helps exclude some of the emulsion-forming polar compounds which can be present in kerosines.

At the present time the degree of hazard from static discharge in commercial operations is not known. But, because of kerosine's greater viscosity and greater tendency to entrain foreign matter, if there is a hazard it could be expected to be more serious in the case of that fuel.

If spilled, kerosine is not evaporated as readily and completely. As a result the danger of fire is prolonged; and if the leakage occurs within a wing, it can definitely be more hazardous.

It must be remembered that reliability and safety are synonymous. To ensure reliability requires a much more appreciative study of conditions (such as deficiencies that might occur through the human element) than has apparently been made by the proponents of "kerosine only."

We feel that these few sincere people who are appealing to the emotions of the public in relation to kerosine *versus* JP.4 are actually doing aviation a disservice; it is a case where a little knowledge on the part of the public can be a dangerous thing to the industry; and, as has been said, it is an industry that has achieved a most enviable record in safety through the conscientious and diligent work of the airlines, the manufacturers and regulatory bodies. They have all worked together, with disagreements at times, but always with the objective of making aviation the safest means of transportation in the world.

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## MR DYMENT'S VIEWS

The following statement, attributed to TCA's chief engineer, Mr Jack Dyment, first appeared in the *Montreal Star* of December 28 (we reproduce it in slightly abbreviated form):—

"In the type of accident that results in fuel being spilled on the ground, JP.4 is more likely to ignite if there is a spark above it than kerosine, and this is all that Lord Brabazon is talking about. Unfortunately, it is far from the whole picture.

"If there is a severe impact—say if a wing strikes the ground and the fuel tanks break open—there is no difference between kerosine and JP.4. You just can't tell them apart if the fuel splashes. In addition, the research agencies of the US Government [NACA] investigated the common causes of fire in aircraft accidents and found that, contrary to popular belief, sparks are not a common cause, because the electrical system goes out in the crash.

"They found the most common cause of fire after an accident is from engine oil or hydraulic fluid coming in contact with hot metal. This is what causes most fires. . . . Kerosine is closer to engine oil than gasoline and they found that it will ignite from contact with hot metal parts as much as 400 degrees lower in temperature than JP.4. . . .

"If you get a leak in a fuel tank in a wing, kerosine will crawl and JP.4 will evaporate. The danger of kerosine coming in contact with a hot part as it did in a Vulcan (in a British bomber accident in which the airplane exploded in the air) [actually a Valiant—Ed., *Flight*] is greater than with JP.4. Engine reliability is synonymous with safety and if you have a flame-out in the air—and you can still get them from icing—you are far, far more likely to get them restarted with JP.4 than with kerosine. There is just no comparison.

"Kerosine burns at a hotter temperature than JP.4 so the engine parts are hotter and this affects reliability. Because of their higher fuel consumption, the tolerances in turbine engines have to be much closer than with piston engines and dirt has a more serious effect. Anything close to oil, as kerosine is, needs a longer time for the dirt to settle out—dirt stays in suspension longer in kerosine than in JP.4.

"In the case of engine fire, with flames coming back over the wing, the vapour from JP.4 will cool the skin of the aircraft faster than kerosine and kerosine becomes explosive for a much longer time. JP.4 will produce an explosive mixture only through a very narrow range of air-fuel mixtures because it quickly becomes too rich to explode.

"There is another factor that we don't know very much about yet—static electricity. Kerosine does pick up static more readily. To what extent a hazard is involved is not known. JP.4 should be better. . . .

"In spite of what I have said, we don't think there is any reason why an airline shouldn't use any of the standard fuels. You must look at your own operating conditions and decide which is preferable. When we selected JP.4, we were told it would cost more than kerosine and we still picked it. As it has turned out, you can toss a coin between them as far as cost is concerned. It depends where you are. And in spite of what Lord Brabazon says, safety has always been the No 1 consideration with all airlines—it has to be. Brabazon is chairman of the Air Registration Board, and if this fuel were dangerous I would say he had been extremely remiss not to have banned it long ago. But, you notice, his board approves it.

"Brabazon is a very good speaker at a luncheon and he's very enthusiastic and he convinces himself. But he is a political appointee on the ARB and no one would consider him an expert."

de Havilland and JP.4: page 69

# The First Handley Page Transports

By PETER W. BROOKS
BSc(Eng), ACGI, AFRAeS

*One of the four O/400s converted for civil use in 1919*

**THERE has always been a good deal of uncertainty about that part of the early history of British transport aircraft development which concerns the O/400 transports produced by Handley Page Ltd in 1919-20 and the origins of the famous W/8 series—the first H.P. aircraft designed from the start for transport purposes. The article is an attempt to rationalize the conflicting information available and to suggest what may have been the sequence of events in the development of these pioneer multi-engined airliners.**

TWO recent books, A. J. Jackson's *British Civil Aircraft, 1919-59* and R. Higham's *Britain's Imperial Air Routes, 1918-39*, throw new light—and revive some old uncertainties—on the rather confused history of development of the first transport aeroplanes by Handley Page Ltd immediately after the end of the First World War.

About 550 of the O/400 series of twin-engine bombers had been built during the war (probably more than of any other aeroplane with a loaded weight exceeding 10,000lb) and it was therefore natural that Handley Page should give immediate attention to adopting their design to transport purposes. They had, in fact, produced before the end of the war two crudely converted O/400s which were used from April 1918 to return ferry pilots across the Channel from Marquise to Lympne. These transports simply had rudimentary seats for 12 passengers inside the bomber fuselage.

During 1918 several O/400s were converted for passenger transport at Farnborough. In these aircraft the fuel tanks, which in the standard O/400 were mounted in the upper part of the central fuselage bay, were removed and replaced by long rectangular tanks extending through to the bomb cell in the lower part of the fuselage. The tanks were covered by slatted seats for about 12 passengers. "Guardian Angel" parachutes were provided for the passengers and a vertical polished hand-pole (as at a fire station) was provided to enable the aircraft to be abandoned by way of the bomb-bay opening which—as in the standard O/400—was normally kept covered with brown paper.

Soon after the Armistice—on December 13, 1918—the RAF formed No 1 (Communications) Squadron at Hendon to carry passengers and despatches between London and Paris during the Peace Conference. The squadron was expanded into a wing in January 1919 and continued to operate until September. At least three O/400s—His Majesty's Air Liners *Silver Queen*, *Silver Star* and *Great Britain*—were converted into VIP transports for use on this operation.

*This O/700, G-EAAF, flew scheduled services in Europe and is believed to have been the first civil transport aeroplane to carry radio*

In these aircraft an attempt was made to improve the comfort of the passengers: the seats were more comfortable, there was internal trim to the passenger compartments, and windows were provided to give the passengers light and an outside view. For what they were, these conversions were quite effective, but they served to emphasize the unsuitable features of the O/400 fuselage when used for this purpose. The fuel tanks occupied a large amount of space in the centre-section and the criss-cross wire bracing of the frames seriously obstructed the interior. *Silver Star* had its main passenger compartment aft of the tanks while *Great Britain* accommodated its passengers amidships, with new tanks apparently similar to those fitted in the Farnborough conversions.

The first civil transport of Handley Page was a further adaption of the O/400 on similar lines to the two RAF aircraft. There were two passenger cabins, one forward and one aft of the fuel tanks, and seats for seven passengers. The forward cabin had two rectangular windows on each side and the aft cabin three. Four O/400s—G-EAAE, F, G and W—were converted to this new standard during the early months of 1919 and, on May 1, were granted what were amongst the first Certificates of Airworthiness to be issued. Handley Page Ltd (and later Handley Page Transport Ltd, formed on June 14, 1919 by Handley Page as an operating subsidiary) started proving-flying on various routes with these aircraft from May 1, when the official ban on civil flying within the United Kingdom was finally lifted. A scheduled service between Cricklewood and Bournemouth was operated during that summer, but scheduled airline services did not start on any scale until after the ban on international civil flying was lifted on August 25.

Strangely enough, the Chinese provided one of the first major incentives for the development of large transport aircraft in this country. Both Vickers and Handley Page sent training missions and aircraft to China in 1919 and both firms produced special transport aircraft for the purpose. Vickers developed the Vimy-Commercial out of their Vimy bomber—which, although too late for the war, achieved fame on several pioneering long-distance flights—and Handley Page produced the O/700, or O/7 as it later became known. The Vimy-Commercial (which first flew in February 1919) had an entirely new wooden monocoque fuselage of oval section, but the O/700 employed basically the same rectangular-section wire-braced wooden framework fuselage with fabric covering as did the O/400. The only important difference was that the wire-bracing of the frames in the centre portion was replaced by steel tubes arranged vee-fashion, thus facilitating fore-and-aft movement in the cabin. At the same time, the fuel tanks were moved out of the fuselage and put back into the engine nacelles where they had been in the O/100, the original model of the O/400 series. The lengthened nacelles were supported by the same arrangement of vee and inverted-vee interplane struts as the earlier aircraft. There were eight rectangular windows along each side of the new cabin, in which eleven seats were arranged singly each side of a central aisle. Entry was by way of a door on the port side at the rear of the cabin.

The first O/700—G-EAGN, which bore the earlier civil registration K-162 and the "private" Handley Page marking HP-1—flew on July 5, 1919 and gained its C of A on August 8. Six of these aircraft apparently went to China soon afterwards. Two or three O/700s were also sent to South Africa and further deliveries to China followed. G-EAAF, one of the original civil O/400s

## The First Handley Page Transports . . .

*G-EASL, one of the first two O/11s; these aircraft were designed for passenger and freight duties*

operated by H.P.T., was converted into an O/700 in August, but it seems to have been the only one of its type to have been used on scheduled services in Europe. However, it was notable as probably the first transport aeroplane to carry radio. The rest of H.P.T.'s fleet apparently consisted of O/400s until the spring of 1920.

It is interesting that, as with the O/7, only one Vimy-Commercial—the famous G-EASI *City of London*, of the Instone Air Line Ltd—went into service with a United Kingdom airline, although both types were operated in some numbers in China.

Although it presumably did not go into service (no C of A was awarded), there was one most interesting development of the O/400 series, apparently known as the W/4, which was flown for the first time on August 22, 1919 by Lt-Col Sholto Douglas (now Lord Douglas of Kirtleside). There is, however, some mystery about this prototype (it may have borne the "private" Handley Page markings HP-15 and seems to have been converted from an O/400 with the serial number C9713) and, as far as is known, no photograph of it has ever been published. Mr Jackson does not even mention it in his book (presumably because it does not seem to have been given civil registration markings), but Dr Higham claims that it went into service with H.P.T. in December 1919. It would be interesting to know what evidence there is for this assertion. The W/4 (it was later retrospectively given the Handley Page type designation H.P.16) seems to have consisted of an O/7 fuselage fitted with new equal-span wings of 85ft span—possibly obtained by cutting down the outer bays of the wings of the much larger V/1500 four-engined bomber—and a new tail unit with single fin and rudder. The loaded weight was reduced from 12,800lb for the O/7 to just under 10,000lb. The interesting thing about this design is that it was a most important intermediate step between the O/400 series and the very successful W/8 design which, with its derivatives, was to succeed the O/400 in production and provide the bulk of Handley Page's business for the next ten years.

The W/4 does not seem to have been a success, but it was used to try out various tail configurations. It was eventually handed over to the RAE after extensive test flying by Capt G. T. R. Hill. Experience gained with the W/4 contributed to the next Handley Page design, the W/8, which also had equal-span wings, although of ten feet shorter span. The W/8 bore the "private" Handley Page marking HP-15 and the civil registration G-EAPJ. It made its first flight on December 4, 1919, and gained a C of A on August 7, 1920. The W/8 was designed to take Cosmos Jupiter engines, but because these were not ready in time it was fitted with 450 h.p. Napier Lions. These took the place of the 360 h.p. Rolls-Royce Eagles in the O/400s and O/7s. The W/8 had seats for 14 passengers. It went into production in 1922 in a modified form with Eagle engines and was then known as the W/8B. The W/8 prototype was, however, used in airline service from October 21, 1921, while the W/8B started scheduled flying on May 16, 1922.

The W/8A was a projected variant of the W/8 with Cosmos Jupiter radial engines in place of Napier Lions. No development of this variant took place, because the Cosmos Jupiter was never approved for normal service. By the time the first (Bristol) Jupiter cleared a type test (in September 1921) the W/8B had already been chosen for production. Thus the later trial installation of Jupiters in an O/10, G-EATK, had no bearing on the W/8A project which preceded it, but was the first link in the chain which included the use of the Bristol Freight Carrier (G-EBEV) on the Cologne route, the re-engining of the W/9, Hampstead and the eventual adoption of Jupiters for the D.H.66 and Calcutta and thereafter for the Kent and H.P.42.

The W/8 prototype, G-EAPJ, in its later life was used to test the gravity fuel-system for the W/8B. Like the W/8Bs, it had tanks on top of the upper wing. All cowlings were removed from the nacelles together with the nacelle fuel tanks. The installation of the Lions was then exactly the same as that in an earlier experimental O/400, G-EASO *Carthusian II*.

About two months after the W/8 made its first flight, Handley Page flew the first of a new development of the civil O/400 series. This was the O/11, which was similar to the O/7 in having a transport fuselage with the fuel tanks in the engine nacelles but with very much strengthened interplane strutting supporting the nacelles. The O/7 struts were the same as those of the original O/100, but the O/11 had a straight interplane strut supporting the rear of the nacelle as well as vee struts. There were also two diagonal struts from the nacelles to the lower wing-root fittings. The O/11 had a mixed passenger/freighter interior with a freight hold amidships and a small passenger cabin with three seats aft. Two rectangular windows on each side lighted the passenger cabin while a number of small irregularly-placed windows further forward let light into the freight compartment. The first two O/11s—G-EASL, "HP-30" and G-EASM, "HP-31"—gained their Cs of A on March 23, 1920, and went into service with H.P.T. in the following month. Five O/11s were built.

The O/10, an all-passenger version of the O/11 with seats for 12 passengers, first appeared about a month after the first O/11s. Eight O/10s were built and went into airline service. They had similar nacelle struts to the O/11 but could be distinguished by the five rectangular windows on each side of the fuselage. The cabins of the O/11 and the O/10 did not extend as far aft as that of the O/7, but both had prominent ventilation scoops and extractors aft of their rear bulkheads. The first O/10—G-EASY, "HP-35"—gained its C of A on June 23, 1920, and went into service soon afterwards. The longest-lived, G-EATH, "HP-38," remained in use until September 1923. By then the W/8B had long been established in service. Thereafter, Handley Page was to produce a succession of two- and three-engined further developments—the civil W/8E and F, W/9 and W/10 transports as well as the Hyderabad and Hinaidi bombers and Clive troop transport for the RAF—which were to maintain the W/8 series in use for more than ten years. A total of about 80 were built in all.

*The first O/10 to go into service. It was an all-passenger version of the O/11, with seating for 12*

*The Aviamilano P.19 Scricciolo (90 h.p. Continental) is now in production (see news item on this page). At a gross weight of 1,540lb, the aircraft cruises at 112 m.p.h.*

# Sport and Business

SPECIAL PUBLICATIONS for the off-airways pilot are an old *cri de coeur* of *Flight's* Sport and Business page. Ideas for a general aviation guide have been semi-officially discussed during the past year and the Ministry is understood to be actively interested in them (indeed, last spring the MoA issued in limited numbers the experimental *Light Aircraft Flight Guide*, an adaptation of *Air Pilot* for private flying). But the format of a definitive publication has yet to be decided and it could be many months before one appears.

While this prevarication continues a source of information has become available which shows how real is the demand for information that illustrates, in more simple terms than that of our current official publications, aerodrome information and the way about Europe's crowded skies. Jeppesen's *Radio Air Route Guide*, complete with plastic plotter and contained within a cowhide binder, is reported by R. K. Dundas Ltd, British agents for the US firm's products, to have reached a volume of sales much greater than they had expected. The Guide gives IFR airways coverage but not let-down procedures for the United Kingdom, Europe, the Near East and North Africa. It includes the admirable Jeppesen facilities charts, area charts for major terminals, an airport directory with airfield diagrams, provision for approach charts and codes, and information of a nature that should certainly be included in any British publication for the off-airways pilot—sections on meteorology, radio facilities, air traffic control, ICAO and national regulations, entry requirements, and emergency procedures. The service includes weekly amendments and pages can be easily extracted from the binder; it is claimed that the maximum time for revisions should be only ten minutes. The *Radio Air Route Guide*, in its binder, measures 8½in × 5½in and costs £19 12s 6d. More comprehensive manuals are available.

Jeppesen equipment offered by R. K. Dundas Ltd, which may be obtained from 59 St James's St, London SW1, includes different types of flight cases for cockpit stowage, ten different types of computers, various plotters, knee navigation boards and briefing booklets. The US service is, in fact, very comprehensive, but it should not deter the Ministry and the Royal Aero Club's aviation committee from active pursuit of a more limited (and more modestly priced) publication matched exactly to the needs of the British general-aviation pilot of 1961.

AN EXPANSION in the field of aircraft maintenance is reported by Grantair Ltd of Grantchester, Cambridgeshire. A full repair service is available for Piper, Auster and other light aircraft: using the road transporter illustrated last week, this service is a mobile one and includes maintenance of aircraft on site. The company's new maintenance base, to be located at Sywell Aerodrome, Northampton, will have Mr G. R. Hampshire as chief engineer. In addition to the maintenance activity at Sywell, Grantair will have aircraft available there for sale and for hire.

A PIPER AZTEC has been purchased by Baker Perkins Ltd of Peterborough for the transport of company executives between Westwood airfield adjacent to the Peterborough works, and subsidiary factory sites at Leeds, Newcastle, Stoke-on-Trent, Twyford and Luton. It will also be used for foreign flights.

UNITED KINGDOM DISTRIBUTOR for the Putzer Aircraft Co of Bonn and the Klemm-Bolkow Aircraft Co of Munich is Flair-Aviation Sales of Bromley, Kent. A British demonstration tour by a Putzer Elster and a Klemm Kl-107 is planned.

LATEST LOCKHEED LASA-60 prototype has arrived at the Lockheed Azcarate factory at San Luis Potosi, Mexico, where preparations for production are well under way. The first prototype received its FAA type certificate last April, but the new aircraft is powered by a 260 h.p. turbosupercharged Continental engine which should provide good high-altitude performance.

THE ITALIAN AERO CLUB issued a specification some time ago for a side-by-side two-seat training aircraft which might be ordered in quantity for the Italian flying clubs. The specification itself raised more than one eyebrow because it appeared to be written round a machine of something like pre-war vintage. A high-mounted wing, tailwheel undercarriage and a wing loading of only 9.2lb/sq ft were among the requirements. A few companies, notably Partenavia, produced designs which followed the specification, but Aviamilano defied it and have now gone into production with the low-wing P.19 Scricciolo. On their own initiative Aeromere are now also reported to be designing an all-metal simplified version of the Falco, which they produce under Aviamilano licence, and it is said to be a potential competitor of the French Morane Rallye.

The Scricciolo is powered by a 90 h.p. Continental engine and has a steel-tube fuselage mostly fabric-covered. Gross weight and wing span are respectively 1,540lb and 33ft 9in. The aircraft made its first important public appearance at the light aircraft show in Venice during last summer and the company is now completing its first batch of ten.

The wing is made in two sections bolted together on the aircraft centre-line, and has a single main spar. Plywood skin is applied above and below the wing between two subsidiary spars fore and aft of the main spar. The plywood is thus only slightly curved and is easier to repair. Glass-reinforced plastics form the leading-edge skin, and the main undercarriage legs are attached to reinforced ribs so that heavy landings do not directly damage the spar. Either nosewheel or tailwheel can be supplied. Early aircraft have a wooden propeller, and later models will have the slightly more powerful 100 h.p. Continental engine. Fuel feed is by engine-driven pump with an electric pump as stand-by. Maximum speed, cruising speed and limiting speed are respectively 124 m.p.h., 112 m.p.h. and 184 m.p.h. Other data are: length, 23ft; wing area, 150 sq ft; wing loading, 10.2lb/sq ft; empty weight, 968lb; useful load, 572lb; power/weight ratio, 17lb/h.p.; minimum speed with flaps, 35 m.p.h.; take-off run, 428ft; climbing speed, 740ft/min; service ceiling, 14,400ft.

## RETROSPECT

***From "Flight" of January 14, 1911***

*A Transatlantic Aeroplane.* Nothing daunted by the failure of the Wellman airship to sail across the Atlantic, an American, Harry Grahame Carter by name, has announced that he will make an attempt to fly across the Atlantic in an aeroplane of his own invention. He has estimated that he can do the trip in 54 hours, and can carry sufficient fuel to do this in the hollow tubing of his machine. He hopes to be ready to start from Sandy Hook early in March. We fancy he is wrong in his starting date.

*Grumman Ag-Cat (450 h.p. Pratt & Whitney) demonstrates the use of the small version of the Swathmaster chemical dispenser. The Swathmaster was developed originally for the Boeing-Stearman Model 75 by Joe Sellers and is manufactured by Transland Aircraft of Torrance, California. This Ag-Cat, with a load of over 2,100lb, is operated by Farmers Crop Dusters of Bakersfield, California*

# ASCENT OF THE

THE first world gliding record ever obtained in a British sailplane, and the first by a New Zealander, was achieved by S. H. "Dick" Georgeson on December 16. Subject to official confirmation, he made a flight in his Slingsby Skylark 3f to 35,700ft—a gain of height of 34,300ft—in the famous North-West Arch, one of the world's biggest lenticular clouds, which forms over Christchurch in a north-west wind. For several years past Georgeson has been exploring this giant wave system, his previous best gain of height being 29,400ft. Philip Wills, who has written the following description of the flight from a letter received from Georgeson, comments that it is splendid to know that the New Zealander's pioneering work has now brought him the record which he so richly deserves.

On the evening of December 15 the weather office forecast a westerly wind which would last for two days. Gerald Westenra drove in to Christchurch from Dunsandel, 30 miles away, and collected the Eagle. Georgeson left Christchurch at 4.15 a.m., towing his Skylark 3, and arrived at Dunsandel at 7.30. Warren Denton, the official observer, took a day off from his sheep-shearing to come and launch him. Both aircraft were rigged, oxygen aboard, barographs sealed, and at 8.30 a.m. the Eagle was aero-towed off on a 300km Gold C attempt. Shortly afterwards the Skylark was off on a 500km Diamond flight, but an hour and a half later both were back on the ground. At 1.50 p.m. Westenra went off again, closely followed by Georgeson. The Eagle came unstuck and landed away from the field. The Skylark was towed 10 miles to Hororata, and released at 3,200ft in a strong downcurrent.

After much struggling, Georgeson contacted what is locally called "thermal wave." The technique for working this is to do two or three circles, after which the lift dies, then go forward to the same spot and wait for the next surge and circle again, and so on. The overall effect is a slow gain of height, which on this occasion brought Georgeson after an hour to 5,000ft. At this height he went quietly into weak, smooth wave lift, a delightful change after the violent surges of the lower air.

Overhead the sky was completely overcast, with cloud base at 17,000ft rising to 19,000ft some 15 miles upwind over the Rakaia Gorge area. By now it was clear that Diamond distance was out, and altitude was very much in. He continued his climb to 25,000ft, and the air became white and opaque with so terrific a glare that it was difficult to see, but he realized that he was in the lee of a gigantic lenticular which he knew formed part of the main North-West Arch. He forced ahead into wind at 100 m.p.h., through a downcurrent that brought him down to 9,500ft over Highbank—half-way to the leading edge of the big cloud—but here another wave took him up to 16,000ft, and forward again into the glorious sunshine ahead of the Arch, where he could look up at the mighty 16,000ft cliff of this gigantic lenticular.

Here, extraordinarily enough, there was no lift in a three-mile band in front of it, so he flew back to the secondary wave over Highbank, climbed to cloud-base, and then went forward again just under cloud to the leading edge. Quietly and smoothly he began to rise, amongst the most stupendous cloud scene ever seen by man. In the accompanying photograph, which was taken by Georgeson from about 32,000ft, it is hard to believe that the depth of cloud is over three miles.

Georgeson says he has never been so excited in his life. All his attention was focussed on the a.s.i., oxygen blinker and the two variometers. Towards the top both variometers became misleading. With an external temperature of minus 50° the Cook showed no lift, while the Cosim kept sticking at 4-5ft/sec up which wasn't there. At maximum altitude the ailerons became very stiff and the canopy completely covered with ice, but otherwise the Skylark flew perfectly.

He removed his oxygen mask to try to hear if the barograph was still ticking. It was fortunate that he had been in the decompression chamber at Wigram a few days before, for he now noticed his finger-nails becoming blue. Having recognized the onset of anoxia he replaced the mask quickly.

On the way down odd patches of cirrus streamed in through minute crannies and filled the cockpit with white powder. Georgeson called up Harefield on his radio, told the controller what he had done, and was thrilled to receive his congratulations and a friendly "good-night."

On landing back at the field, Westenra and Denton greeted him, the latter extracting from the Skylark, and guarding with his life, the large iced wedding-cake which the recording barograph had now become. Westenra had had bad luck in the Eagle. On his third attempt he encountered extreme turbulence, his straps were not tight enough, his head went through the canopy, and a subsequent gust blew a large part of it away completely. These big waves are not to be taken lightly.

An hour later, the metal parts of the dismantled Skylark were still, in the warm summer air, covered with frost.

# NORTH-WEST ARCH

# Straight and Level

PORTSMOUTH has quite a number of rather unpleasant-sounding street names, and the council wishes to eliminate them. One of these is Rat Lane, which leads to the old Airspeed works (now D.H. Portsmouth).

The street has just been renamed Norway Lane in memory of the late Nevil Shute Norway, a founder of Airspeed and famous also for—well, there's no need for me to tell you well-read lot what Nevil Shute is famous for.

Anyway, there's a nice little rat's-tail-piece to this story, for which I am indebted to the *Portsmouth Evening News*. The brownish-grey rat, which has largely exterminated other species—notably the black rat (rattus rattus)—in this country is none other than the Norway rat (rattus norvegicus).

● Last week the *Daily Telegraph* published a feature article by Air Cdre L. G. S. Payne, who is the newspaper's air correspondent, about the future of British private flying.

It was good to see such prominence given to this subject. But nowhere in the article was there any mention of Beagle. "In recent years the only British firm designing small single-engined civil planes and selling them in appreciable numbers," said Air Cdre Payne, "was Auster Aircraft. It is now a subsidiary of the Pressed Steel Company."

The next paragraph began: "There are about 23 United States companies . . ." and listed the numbers of light aircraft producers in France, Italy and Western Germany.

Many readers may have been excused for thinking that, as the author went on to say, British manufacturers are doing no "more than dream about a new golden age for private flying." And that there are "few signs of reasonably priced vehicles of this kind being available for private flying in the foreseeable future."

To write an article about the future of British private flying without mentioning Beagle is like listing Britain's leading national newspapers without mentioning the *Daily Telegraph*.

● I remember suggesting when Shorts named their big new SC.5 freighter the Britannic (this column, February 20, 1959), that "if we want to sell our goods in neutral-country markets we should acknowledge the psychological importance of neutral nomenclature."

I wonder whether it is for this reason that Shorts have renamed this aircraft the Belfast? It doesn't really matter, because I don't think that names sell aeronautical products anyway.

I am sure there is no harm in the naming game, except perhaps that time is wasted dreaming names up. But it is significant that our chief competitors manage to sell their aircraft without naming them all—Boeing 707, Convair 990, Douglas DC-8, Boeing 727, to name (or number) but a few.

I am sure that the D.H.121 would have sold just as well as the Trident, and that the Rolls-Royce RB.163, its power-plant, would have sold just as well as the Spey.

*Passing thought:* Surely a trident always has three tines?

● Talking about names, the Irish appear to have one name for their airline for every day of the week.

A press release I saw lying on a colleague's desk the other day was headed Aer Lingus Irish Air Lines, though the subject matter concerned a new appointment in Irish International Airlines. This, it seems, is the name of the marketing company in North America, but it appears on the fuselages of their Boeing 720s—though on the wings it is written as Irish Air Lines, a name which in some official publications is, however, rendered as Irish Airlines.

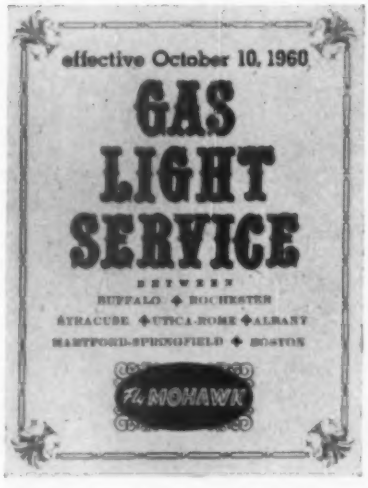
The whole thing is quite simple really. Overseas they are known as Irish International Airlines (alternatively Irish Air Lines or Irish Airlines), while in Europe they are Aer Lingus, a company owned by Aer Rianta. And one mustn't leave out Aerlinte Eireann, which occupies a very important position in Ireland's civil aviation set-up, as indeed does Aer Linte Teoranta.

Anyway, good luck to the Irish, under whatever name they may operate. They may not know their name, but they know where they're going, as an article elsewhere in this particular issue of *Flight* suggests.

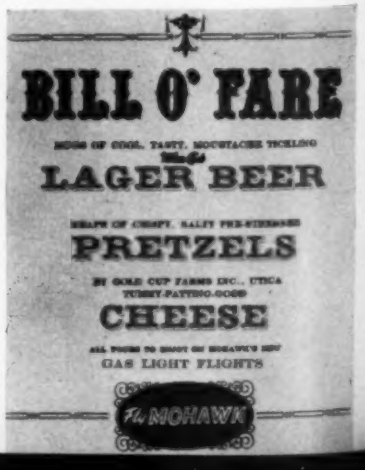
● Do you remember the statement about 18 months ago by Mr Aubrey Jones, then Minister of Supply, to the effect that Britain's aircraft industry would have to contract, in terms of work force, from about 250,000 to about 150,000? I publish without comment the following extract from a recent SBAC news letter:—

"The industry's labour figures during 1960 (January-September) showed an increase from 279,600 to 283,500. The president of the society said during display week that 'the difficulty will be to get enough people' to fulfil the industry's commitments."

ROGER BACON




A few weeks ago I recorded with pleasure a new "Victorian Gaslight" DC-3 service between Buffalo and Boston being operated by Mohawk Airlines. The aircraft cabin, I noted, is decorated with antimacassars, red velvet curtains, brocade wallpaper, gilt framed pictures and carriage lamps, and the stewardess is dressed in Gay Nineties costume. Subsequently sent to me, and presented herewith, are pages from the timetable



# Correspondence

*The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. Names and addresses of writers, not for publication in detail, must in all cases accompany letters.*

### Free Aviation ?

OF all the excellent ideas and examples which we may import from the United States during the re-birth of progressive non-commercial aviation in this country, I hope that the term "General Aviation" will not be one of them. This Americanism, which is being increasingly used over here apparently for lack of a better term, is surely most impersonal and meaningless.

Perhaps your readers would have suggestions for a good alternative which would have an all-embracing meaning and yet could be broken down into those particular aspects which we all know and wish to retain, such as private, club, business, etc. May I suggest the term "Free Aviation." Free of Government restriction (we hope); control (we hope); interference; subsidy. Free of archaic commercial agreement, lop-sided competition and aeronautical ballyhoo.

Like all terms, this one would also be open to abuse and the passage of time may well make it a nonsense, but it would have a challenging ring about it which should help the general public to see the various aspects of non-commercial aviation in their true context within the overall pattern of British aviation.

At the moment the general public have little or no idea that anything other than the great scheduled airlines exists, and as they become increasingly aware of all other forms of aviation it is surely only right that they should connect them with an overall term which attempts to mean something rather than hold itself out as a sort of aviation left-over. In the years ahead, the ability of the public to make this distinction may well be the most important factor in the survival of British aviation.

Redhill Aerodrome, Surrey J. V. HOSE,
Director, Business Aviation Ltd.

### "First with the Finest"

IT is the opinion of many people in aviation circles in North America that Gt Britain will have two of the most advanced transport aircraft in the world, the VC10 and the Airco D.H.121, if she is capable of delivering these craft in 1962.

There is the realization here that, although the British aircraft industry is capable of designing outstanding aircraft, they are quite incapable of producing these aircraft at the particular time when their advanced features can be best exploited. In other words, the period of time taken from the drawing board to the runway is far too long.

On the other hand, the American producer, although handicapped by the demands of a ravenous growing giant, the American Space Program, is able to formulate and produce the aircraft needed by the world's airlines at the earliest possible time.

A typical example will, no doubt, be the Boeing 727 Jetliner. Recently conceived, this aircraft has already received orders totalling 80 aircraft from Eastern and United Airlines worth $350m. The aircraft, which bears a striking resemblance to the Airco D.H.121, will no doubt be delivered to the world airlines long before delivery of the 121 is completed to BEA.

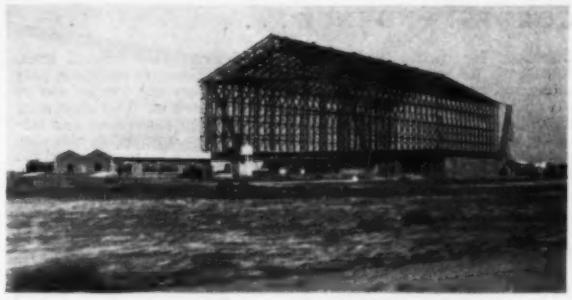
When will the British aircraft industry realize that early delivery is most essential in this fast-moving age? One of the more recent examples is the almost late arrival of the Vickers Vanguard on the medium-haul turboprop scene. If it had not been for the difficulties of its competitor, the Lockheed Electra (which, incidentally, has sold very well), I am sure that apart from BEA and TCA, very few other airlines would have had the opportunity to take advantage of the outstanding features of this very fine aircraft.

There has been much said on the question of building a supersonic airliner. However this question is argued pro and con in Britain, you can be sure that such an aircraft will be built in the United States, and far earlier than most people think, for the simple reason that the prestige and research involved in such a venture is essential to any industry that is interested in staying in business.

The British aircraft industry will never have a better opportunity than right now, by taking advantage of the handicaps placed on American aviation by the demands of space technology. Let us have more crash programmes of the Avro 748 type, and make the British aircraft industry's slogan "The First with the Finest."

Toronto 6, Ontario D. F. MERRIGAN

[Some of the opinions expressed above will certainly not be universally shared in this country; but the letter is printed as it is indicative of a line of thought not uncommon across the Atlantic. —Ed.]



*The "disappearing" R.101 hangar (see Capt Somerton-Rayner's letter)*

### Disappearing Landmark

I AM enclosing a photograph [reproduced herewith.—Ed] I took on a recent flight from Malaya in my Auster. As you will see it is the end, the very end, of the airship R.101 and its flight to India, in that the famous airship shed built at Karachi, and never used, is at last being dismantled for scrap. It will be the disappearance of a landmark for Karachi Airport, a rather essential one in a complex of five airfields all within a few miles of each other.

The photo was taken at the end of October and may possibly be of interest to nostalgic readers.

Middle Wallop, Hants M. SOMERTON-RAYNER
Capt, Army Air Corps

### Wüsthoff's Last Flight

REFERENCE the letter from J. W. A. McGregor on page 956 of *Flight*, for December 16, 1960. The following are the facts upon which the painting to which he refers is based:—

(1) Capt Southey of 24 Sqn RAF, flying SE.5a D279 on June 17, 1918, attacked the Fokker D.VII flown by Wüsthoff in the course of an engagement between thirteen British and ten German aircraft at about *12,000ft*. Wüsthoff subsequently stated that this first attack, from 100-150yd range, wounded him and stopped his engine, and was thus the crucial point of this whole affair.

Our painting, as was our intention, correctly shows *these* circumstances and not the *final stage* of Wüsthoff's crash, to which your correspondent obviously refers.

(2) The enclosed photograph [reproduced below.—Ed] shows Wüsthoff's Fokker D.VII after salvage at 24 Sqn's aerodrome at Conteville. The "skull and cross bones" was the personal marking used by Georg von Hantlemann, the previous "owner" of this D.VII, and is also to be seen on this pilot's Albatros D.Va of an earlier period. In both instances certain common artistic characteristics are apparent.

(3) Capt Southey, who remarks that "this particular encounter stands out very vividly in my memory," noted that "*on either side of the fuselage was painted a large skull and cross bones in white.*"

Although we are aware of the dangers of dogmatic statements concerning aviation history we feel justified in claiming that the above evidence proves our painting to be a correct portrayal of this combat.

Letchworth, Herts E. F. CHEESMAN
*Editor, Fighter Aircraft of the 1914-18 War*

TO someone whose interest in World War 1 aviation is of necessity derived from books, an eye-witness account of an incident such as Wüsthoff's last flight is like a breath of fresh air. Perhaps I might add a little to Mr McGregor's account as published in *Flight* for December 16?

The official history of No 24 Sqn by Capt A. E. Illingworth contains the following for June 17, 1918:—

"A big fight over Villers Bretonneux between thirteen of our machines and ten Fokker biplanes, in which we bagged, amongst others, Lieut

*Wüsthoff's Fokker D.VII (see letter above from Mr E. F. Cheesman)*

## CORRESPONDENCE . . .

Wüsthoff. He was wounded and shot down in the French lines. Apparently he had left the late Baron von Richthofen's squadron only three days previously to take command of another and was by way of showing how to shoot down a balloon when we blew in. This effort after the balloon accounted for the Huns' unwonted appearance on our side of the Line. Lt Wüsthoff had 27 victories to his credit and at this time was fourth on the enemy's list of 'aces.' We collected his machine and . . . the rudder and fin went to adorn our notice board."

The list of decisive combats in the same book indicates that the credit for the shooting down of Lt Wüsthoff was shared by three officers of No 24 Sqn, Capt I. D. R. McDonald, MC, DFC; Capt G. O. Johnson, MC; and 2/Lt H. D. Barton, DFC.

On the same day 2/Lt W. C. Lambert, DFC, shot down two aircraft, one breaking up in the air and another falling in flames, and these two victories are presumably the "others" mentioned above.

Are there any other readers who, like Mr McGregor, can supply first-hand details of this combat?

Windsor, Berks — C. JOHN BARRON

### Who Designed the Famous Sopwith Types?

WITH reference to Wg Cdr Norman Macmillan's article in your issue of December 30, I was not aware that any mystery existed as to the identity of the Sopwith Aviation Company's chief designer, and I enclose a photograph [reproduced herewith—Ed] of Herbert Smith. He came to Kingston in March 1914 and became chief designer in November of that year. He was responsible for the development of all Sopwith projects from then on, including the Pup and the Camel. This is evidenced by the fact that all principal assembly drawings are "Approved H. Smith," while component drawings are simply countersigned by Ashfield. What I am unable to confirm is whether Smith was responsible for the post-war commercial designs, the Wallaby, Gnu, Atlantic and Antelope.

Cobham, Surrey — FRANCIS K. MASON

### The New York Collision

WHEN I saw the diagram relating to the probable tracks of the relevant aircraft in the recent New York air disaster (*Flight*, December 30), I was reminded of the Decca chart (*Flight*, January 30, 1959) of a Comet approach to London Airport. One can easily see from this that the aircraft began to take a course to land on runway 28L but turned off to land on 23L. These runways are approximately one mile apart and it is reported that the DC-8 was six miles off course, and the following questions spring to mind: (1) if the DC-8 had been using a Decca Navigator and flying on a prescribed course, would there have been an accident? (2) should not BOAC fit this equipment in their jets to prevent a possible recurrence of this disaster?

Feltham, Middx — J. DAVIES

P.S. I have no interest in the Decca Co, other than goodwill.

### Not-so-Rampant Lion?

READING your article headed "Judah's Lion Rampant" on page 763 of your issue dated November 11, I found myself with rather a different impression than that gained after two visits to Ethiopia. These visits took place in August 1959 and January 1960 and are, therefore, recent enough to have taken place during the period to which the article referred. However, my experience has been solely on the international services of Ethiopian Airlines and were from Frankfurt to Addis Ababa and back to Khartoum and from Cairo to Addis Ababa and back to Athens, in each case travelling on their DC-6Bs.

My knowledge of the airline set-up is very limited, but from what I have learnt from the crews of the aircraft and from individuals in Addis Ababa, I understand that they have a complete monopoly of all services within Ethiopia, that foreign airlines can only land at Asmara and then have to hand their passengers over to Ethiopian Airlines for the rest of their journey, and that their DC-6 planes are on loan or rented from TWA who, I understand, organize the airline and train its personnel and supply the captain on each of their international machines.

I feel, therefore, that your praise of this airline would be of more value if such points were made clear to your reading public because it seems to me, in point of fact, that any airline in a similar position would be most remarkable if they failed to make a resounding success of their services.

I cannot, of course, know exactly what you mean when you refer to the peculiar adverse environment in which EAL operate, but if you are referring to the nature of the country, I would have thought that this would have been very much in favour of any airline, because whereas it may only take an hour or two between the principal towns by air, it can take the same number of days by surface, especially for freight; and as I am again given to understand by friends, because I have no personal experience to go by, the only train service—from the port of Djibouti to Addis Ababa—is so subject to theft and pilferage that the only safe way of getting goods to Addis Ababa is by air. I would, therefore, be extremely surprised if it were not the case that people are tumbling over themselves to send freight by air; and further, although the Italians produced some quite good roads between the main centres, the standard of lorries and buses which use those roads is so poor that the fate of valuable cargo and the comfort of travellers leaves much to be desired.

Having said all that I do not wish to infer that EAL are not to be congratulated on what they are doing, but I feel that your article is not likely to put their position in its true perspective. I believe they have a first-class safety record and maintain a high rate of regularity, and I can certainly confirm that international services on their DC-6Bs are comfortable and happy; but when you mentioned their intention of buying jet aeroplanes to face competition, I must ask from whence comes the competition, for unless foreign airlines are to be given the right to fly services within the country, I can see no possible competition to EAL, and from my rather limited experience of the passenger loads carried on their international services, I cannot imagine any call for any aircraft larger than the DC-6Bs.

Birmingham 1 — R. N. DIXON, Managing Director, Rabone, Petersen & Co Ltd

### 707 Statistics

HAVING greatly enjoyed reading and seeing the fine selection of 707 series (including 720s) photographs on pages 672 and 673 in your Oct 28 issue (recently received in Nairobi), may I point out one omission under the heading of "Leased 707s"? In the winter of 1958-59, PanAm leased to National Airlines (of Miami) two of their original 707-121s. These aircraft were exclusively used on the highly lucrative New York/Miami schedules of National.

Regarding your own estimate of about 9,000 tons (basic weight) covering the 160-odd 707s and 720s delivered to fifteen different airlines since September 1958, I'm somewhat puzzled by your "comparison remarks." You state, "this equals *seven years' production* of 280-odd DC-6Bs." Do you mean that 160-odd 707/720 series built is equivalent in weight to a total of about 1,960 DC-6Bs? Copies of Douglas annual reports in my possession disclose a grand total of *all* the DC-6/DC-7 series—totalling exactly 1,041 aircraft built and delivered in the twelve-year period 1947-59. I'd much appreciate your clarification of the DC equivalent of 160-odd Boeings in terms of basic weight.

Nairobi, Kenya — DENNIS M. POWELL

[About 280 DC-6Bs—plus other airliners—were built in the seven-year period 1952-58. The 280, we calculated, would have been equivalent in basic weight to 160-odd 707-720s.—Ed.]

### The First Night Flight

MR GIBBS-SMITH is quite right to place due weight on the recollections of the eminent English pilot (I wonder which one it was at that time—Cockburn, Bertram Dickson?) and also Harry Delacombe. I knew him well and also his son Roy. Harry's French, as became his name, was fluent. I think the answer is that Harry Delacombe would find it tedious to converse in English with Farman, and Farman would find it so much more easy to converse in French to someone who was near his equal in French, because French was his native tongue, and his whole life had been spent in France. The English aviation world and possibly the Press as well, seeking to bask in the high reputation of this "British" inventor and pioneer, certainly urged Farman to avow British nationality now that fame had reached him. And I can confirm that Farman certainly gave the matter consideration, but after reflection he told me that as his whole life had been spent in France, and he had come to consider himself a Frenchman, he decided he would not change his nationality.

As to the calligraphy, or even the composition of Farman's letter, I have studied the document, since Mr Gibbs-Smith's startling conclusion. I agree that the signature is deeper in imprint than the text, but then many of us develop bold or characteristic signatures that bear no relation to the text of what we have written above it. On phrasing, I do not draw the same inferences either. "Dear Friend" is typically Gallic. The spelling "Graham" instead of "Grahame" I think is significant. The opening, "I beg you to excuse me," is redolent of the French "Je vous prie de m'excuser," and, take another example, "but as I have given you most of my time I must also be of help to Monsieur Paulhan." The inclusion of Monsieur as a prefix to Paulhan I regard as significant. But the whole sentence bears the mark of French construction. An Englishman would have phrased it differently.

Polperro, Cornwall — F. NETTLEINGHAME

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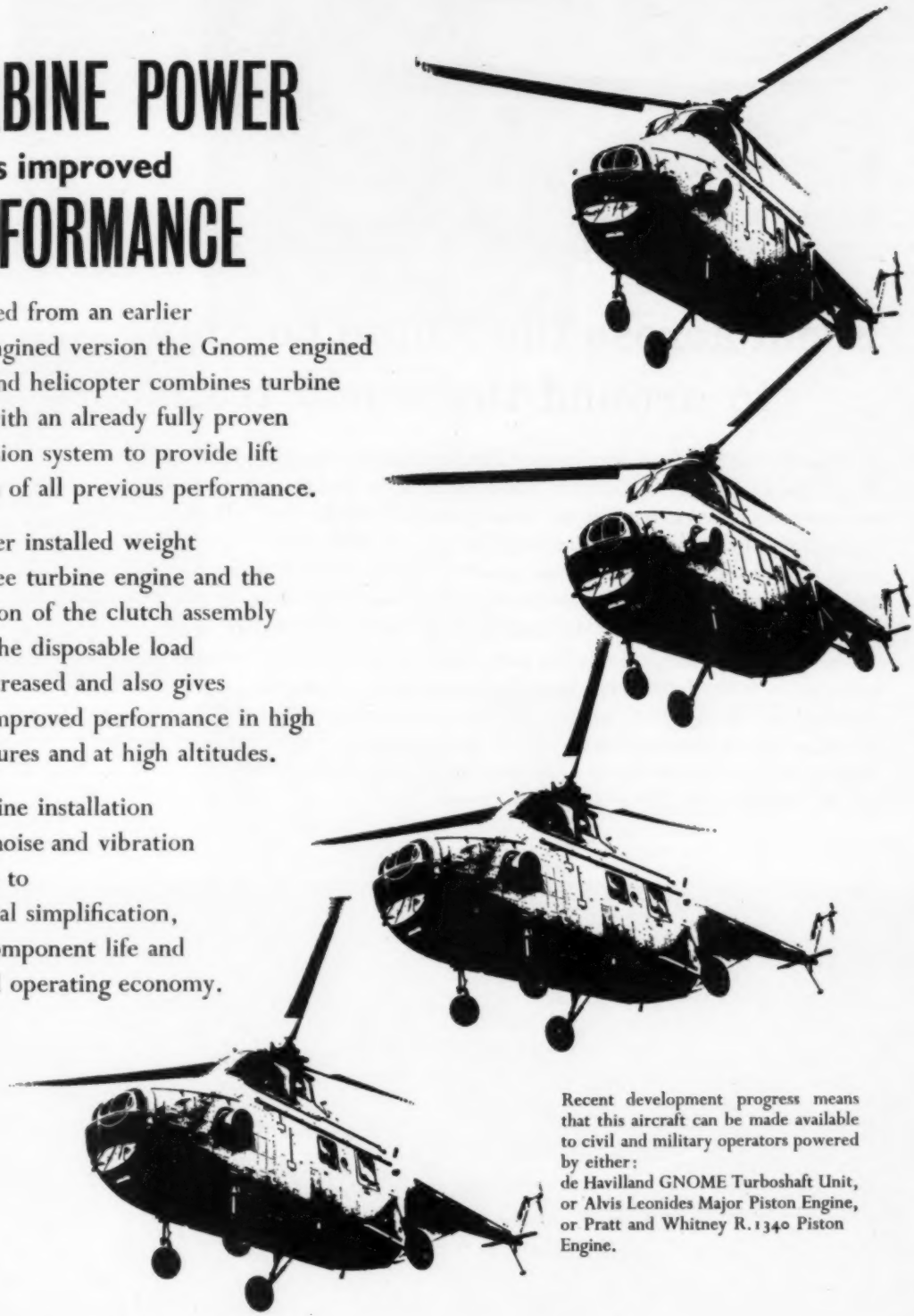

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*D.H.9A at Cologne, 1918*

# From across-the-Rhine bombing to around-the-world transport

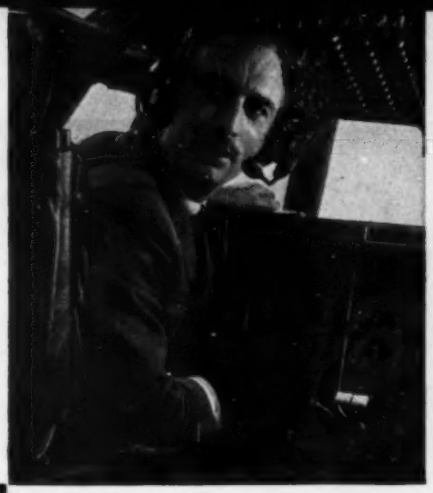
99 Squadron has had three lives. It was formed as a strategic bomber squadron of the Royal Flying Corps in August, 1917. The gallantry of the daylight raids into Germany in 1918 was eventually commemorated in the squadron motto 'Quisque tenax'—'Each one tenacious.' Disbanded in 1920, the squadron re-formed in 1924 as a night bomber squadron.

Based in India for most of the war, the squadron, operating with Wellingtons and later with Liberators, carried out many successful attacks on Japanese-held bases. 99 became noted for the accuracy and regularity of its bridge-busting on the Burma-Siam railway.

When the Japanese retreated they left many British prisoners-of-war in Rangoon jail. 99 Squadron successfully dropped supplies into the jail itself—a tricky job which, in a way, foreshadowed the squadron's next role. In 1947 the squadron re-formed at Lyneham, this time as a long range transport squadron. And in 1959, 99 Squadron took delivery of the first military version of the Britannia which carried a payload of over 15 tons.

99's first aircraft—the D.H.9—carried one 230 lb. bomb.

*Britannia over Kilimanjaro, 1960*



-year-old Wing Commander W. E. F. Gray, *educated at Ottery St. Mary Grammar School, joined the R.A.F. in 1942. After training in Saskatchewan under the Empire Training Scheme he became an instructor on Ansons; after this his instructing duties ranged from Tiger Moths to Lancasters. 1948 saw his first experience of a Transport Command squadron—with 216 in the Middle East. In 1952 he spent a year as Squadron Leader (Training) at the Central Flying School. Then followed a 3-year tour in the Directorate of Flying Training and two years on Transport Command Examining Unit. He became a Flight Commander in 99 Squadron in 1958 and took over command of the Squadron in October, 1959. He has logged 200,000 miles in the Britannia to date. His comment on the aircraft is to the point,—'No vices'. He is married and, when he finds the time, likes to go fishing or rough-shooting.*

27-year-old Flight Lieutenant Keith Shorrock *has been navigating on world routes since he was 20 and has logged well over 400,000 miles. Educated at King George V School, Southport, he joined the R.A.F. in 1951. After training he joined 84 Squadron in Fayid, Egypt, and was on detachment to Cyprus in 1956. Did a round-the-world trip in 1958 via Australia, Christmas Island and U.S.A. Has also flown to Barcelona, Nairobi, Gold Coast, Canada, Fiji, Honolulu. Looking forward to flying on the Singapore-Hong Kong run. Single, he lives on the station at Lyneham where he runs the sailing club. (He sails a Firefly dinghy and recently crewed in the R.A.F. sailing championships). Likes fell-walking in the Lake District.*

26-year-old Flight Lieutenant Dave Ray *never had any doubts about the career he wanted. Starting in the A.T.C. at 16, he joined the R.A.F. in 1951 as soon as he was 17½. After advanced flying training he went on to Vampires and joined 16 Squadron in Germany. Then, in 1957, he converted to Canberras and joined 69 Squadron which moved to Malta in 1958. Came to 99 Squadron in 1959 as a Britannia co-pilot and has already logged over 90,000 miles. Thinks the Britannia is 'beautiful to fly' but also likes to keep his hand in at gliding at the R.A.F. club nearby. He expects to be an aircraft captain within a year and hopes to be posted abroad. His wife is keen to go, too; no comment from his 1-year-old daughter.*

-year-old Squadron Leader . H. Burgess—*always called Pat, despite his initials, because he was born on St. Patrick's Day—is the doyen of the squadron's navigators. Joined the R.A.F. in 1942, commissioned in 1943 with 78 Squadron, Bomber Command, and awarded the D.F.C. after 32 Halifax raids over Germany. Joined 96 Squadron in 1945 on supply-dropping to the 14th Army. The offer of a permanent commission in 1946 changed his mind about becoming a science master. Promoted to Squadron Leader in 1954 while in the Middle East with 78 Squadron again. Joined 99 Squadron, after a period at Staff College, in 1958. His scientific background came in useful in helping to devise techniques for using Britannias economically. He recently flew to Cape Verde Islands; he recommends the local wine which is cheaper than beer. Keeps fit with Scottish dancing and keen, inaccurate tennis. Married, with two daughters.*

# The R.A.F. still needs men like these

The Britannias of 99 Squadron don't waste any time. When they take off they go up at an angle of climb that means business. The business is long range support of our overseas forces. This covers a huge range of activities.

To begin with there are the flights in support of the V-bomber force which have earned Transport Command the description of 'the other half of the deterrent'. Again, the Squadron could be called on 'fire brigade' duty, that is to transport fully equipped troops to a danger spot. Then there are the 'milk runs'—the routine flights carrying passengers and freight to stations extending around the globe. Finally there are special runs—flying out urgently needed equipment, or perhaps on aero-medical evacuation (there are plug-in points for iron lungs from the Britannia's own electrical system).

Maintaining 'the other half of the deterrent' obviously calls for men who can take responsibility. It is no exaggeration to say that the captain of a Britannia has one of the most responsible jobs in the world. His own particular skill must be beyond question and he must also be able to get the best out of his crew. He is solely responsible for the safety of his passengers and his freight, not to mention a £1½ million aircraft. He must be familiar with world routes—weather conditions, the characteristics of different airfields, maintenance facilities. He has to be aware of political conditions in the countries he flies over or to, and must sometimes have the gloved touch of the diplomat. Airman, leader, technician, the captain is all these, and he certainly earns his very good pay.

During the next five years Transport Command will double its operations and the demand for aircrew will increase in proportion. Pilots are now being accepted for training direct from R.A.F. Flying Schools and these men have every chance of becoming captains of their own aircraft within four years.

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**You will be sent full details of the latest pay and career structure, together with an illustrated booklet. This contains the addresses of the R.A.F. Careers Information Centres where you can call in if you would like to talk things over.**

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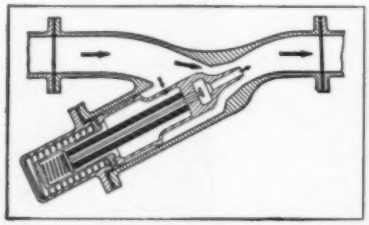
Fuel passes through the minute interstices between the discs leaving solid impurities at the edges. Any water present causes the paper to swell, with a consequent increase of back pressure, which gives an indication that servicing is needed.

Bottom left is the Fuel Monitor, designed in conjunction with the Shell Petroleum Company Ltd. This is a fully "fail-safe" device, consisting of a valve and a water sensitive element, continuously sampling the flow of fuel and causing the main valve to close if water contaminated fuel is revealed.

Bottom right is the high-output MC filter, giving what is for many purposes an acceptable filtration efficiency at a much higher rate than the K type.

NEW THREE STAGE FILTER. Stream-Line Filters Ltd., have recently developed a three-stage filter/water separator which uses pleated elements made from paper, fibreglass and nylon to remove from aviation fuels all solid impurities and all water, in whatever proportions they may arise.



STREAM-LINE FILTERS for aircraft refuelling

**STREAM-LINE FILTERS LTD., HENLEY PARK NORMANDY, NR. GUILDFORD, SURREY**

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SP102

*The Industry*

# Testing Propeller Blades

## DOWTY-ROTOL FATIGUE AND CORROSION STUDIES

WITH Dowty-Rotol propellers in service on over 500 turboprop airliners logging an average of 10,000 operational hours a day, the company finds it essential to maintain a fatigue-testing programme. With the collaboration of the various aircraft operators, blades that have had varying periods of service are returned to Dowty-Rotol and subjected to fatigue tests at different alternating stress-levels in order to compare them with new blades that have been tested over a similar range.

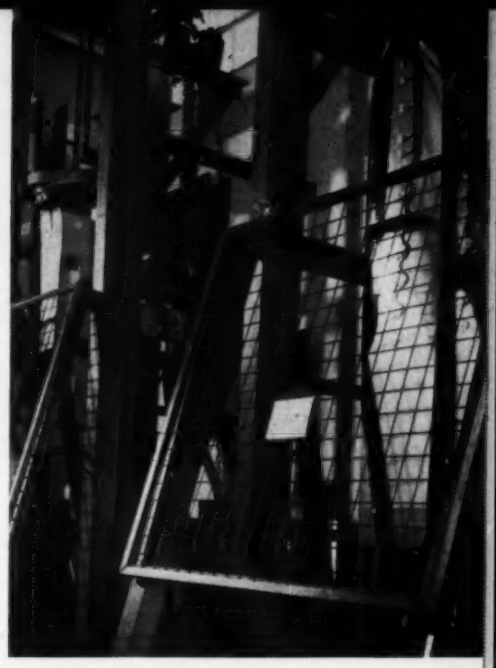
By this means it is possible to predetermine the fatigue-strength effects for increasing periods of service, thereby providing advance information which in turn allows sufficient time for any necessary corrective action to be taken. Turbo-propeller blades with operational periods ranging from 2,000 to over 10,000 hours have been tested, and blades with service lives of from a few hours to over six years old have been returned by airline operators under the scheme.

Blades of standard 10ft-diameter propellers returned for test are first mounted in a rig and vibrated for one hundred million reversals at an appropriate stress to check the outer portion. Basically, the rig is built round a suspension frame to which the shank end of the blade is secured by a standard blade bolt. A moving-coil vibrator driven from a one-kilowatt amplifier is used to vibrate the blade at a resonant frequency by means of a feed-back circuit to the amplifier. The stress produced in the blade is then measured by strain-gauges attached to the surface, the resultant signals being fed into a calibrated amplifier and cathode-ray oscillograph system.

Following the full-length test, the blades are cropped by 28in from the tip in order to obtain a stress distribution with the maximum stress located at the 20 per cent radius. This is the area where the maximum flexural stress occurs in flight. Each cropped blade is mounted in a suspension frame, the shank end being held by a standard bolt. In nearly all cases testing is continued until a crack develops; in general, this is indicated by a drop in stress-level along the blade. Given below is a table of typical test results.

| No. | Flying time completed (hr) | Time since manufacture (years) | Max stress (lb/sq in) | Stress at failure pos. (lb/sq in) | Reversals completed (millions) |
|---|---|---|---|---|---|
| 1 | 1,956 | 2.00 | ±15,000 | No failure | 743 |
| 2 | 2,320 | 2.62 | ±18,400 | ±16,900 | 1.21 |
| 3 | 3,243 | 2.00 | ±15,000 | No failure | 234 |
| 4 | 4,529 | 3.00 | ±15,000 | ±14,300 | 7.62 |
| 5 | 5,322 | 3.75 | ±12,000 | ±10,700 | 589 |
| 6 | 6,476 | 4.42 | ±13,000 | No failure | 550 |
| 7 | 7,023 | 3.17 | ±14,000 | No failure | 510 |
| 8 | 8,780 | 4.33 | ±17,200 | ±16,300 | 3.4 |
| 9 | 9,568 | 4.75 | ±16,000 | ±15,400 | 6.4 |
| 10 | 10,538 | 6.33 | ±16,000 | ±13,000 | 14.45 |

The figures thus tabulated, together with the test results of all the other blades returned by operators, are converted into a series of curves from which an analysis of the fatigue problem is obtained. This analysis is then utilized to correct any undesirable trend in fatigue characteristics well before any appreciable deterioration can occur.



*Sets of blades on the Dowty-Rotol fatigue-test rig. They are subjected to a vibration test of a hundred million reversals and then cropped by 28in for a further test*

In the original turboprop applications, blades were polished at the operator's request and therefore had no protective treatment. One of the adverse features brought to light by this fatigue testing programme was the surface corrosion present to some degree on such blades. This type of corrosion, if allowed to develop, could appreciably affect the fatigue life of a blade. An example of surface corrosion, magnified 150 times, is illustrated.

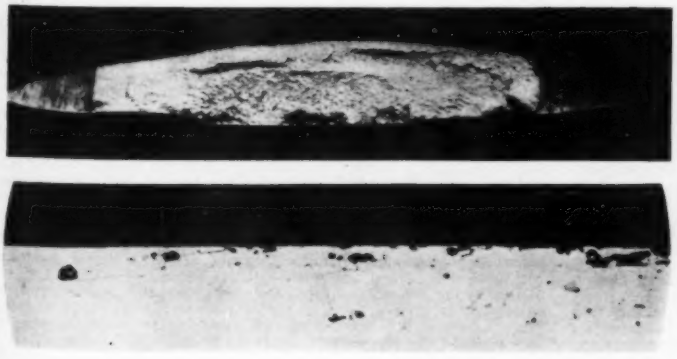
A fatigue-test programme, of the nature previously described, was carried out and proved that if 0.005-0.010in of material was scurfed off the blade surface the fatigue properties were entirely restored. The results of the tests also emphasized the necessity for protecting the surfaces, either by anodizing or the application of an epoxy-resin paint.

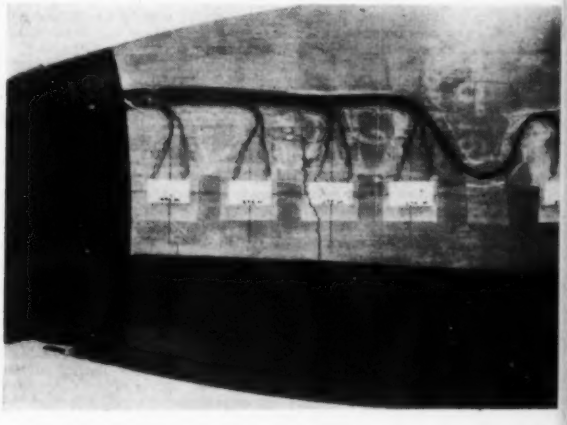
A further analysis of the results indicated that the effect of surface corrosion was more a function of total time in service than of flying hours. This effect was also more pronounced with certain operators, the variations being accounted for by differences in operating and climatic conditions.

The fatigue testing of blades is but one of the routine test programmes applied to Dowty-Rotol propellers. Parallel tests are continuously being carried out on hubs and on the blade-retention assembly. All this operational and test experience—which began with Dowty-Rotol propellers on the first turboprop airliners ever to fly—is now being applied to the new generation of turboprop-powered aircraft, including the Avro 748, Fokker and Fairchild F.27, Armstrong-Whitworth Argosy, Grumman Gulfstream and the Japanese YS.11.

In addition, Dowty-Rotol are now working on propeller-type devices for VTOL applications; on the Dowty Group stand at the 1960 Farnborough Show was a model of a turbofan with variable-pitch blades, representing the company's contribution to this problem. Dowty-Rotol Ltd are also engaged on making specialized impeller equipment for hovercraft.

*Below, specimens showing a fatigue-test fracture and corrosion effects. Right, a blade after test, showing strain-gauges; a fatigue crack is apparent (mag.×150)*





## THE INDUSTRY . . .

### Weybridge Appointments

TWO appointments recently announced by Vickers-Armstrongs (Aircraft) Ltd are those of Mr J. Ferguson Smith, FCA, as deputy general manager and of Mr J. A. Pull, engineering manager, as a special director of the company.

Mr Ferguson Smith joined the Vickers Group in 1950 and was made commercial manager of Vickers-Armstrongs (Aircraft) Ltd in 1958, becoming a special director of the company in January last year. Mr Pull, who entered the aircraft industry in 1923 with Supermarine at Southampton, went to Weybridge as chief planning engineer in 1937. By 1946 he headed a team which was subsequently to engineer production of the Viking, Valetta and Varsity, the Valiant, and the Viscount and Vanguard. This team is now engaged on a programme including the VC10 and TSR.2.

### English Electric Developments

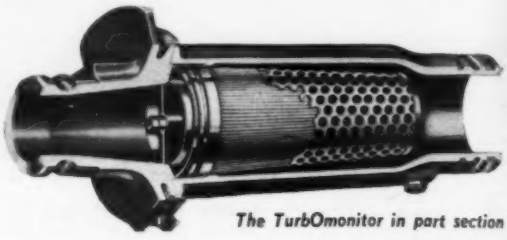
IN a review of their activities for 1960 the English Electric Co Ltd mention the new electrical equipment for aircraft—brushless generators, transistor voltage-regulators and static sensing units—which they introduced during the year.

The brushless-rectifier a.c. and d.c. generators have integral main and permanent magnet pilot exciters ensuring high fault-clearing capacity, rapid voltage build-up and independence from other sources of power supply. It is stated that the transistor voltage regulators (being manufactured for use with either a.c. or d.c. generators and having no moving parts) give close voltage control with fast response, have no hysteresis effect, do not require trimming and are unaffected by acceleration and vibration. The static sensing units are made for the protection of three-phase a.c. systems in aircraft against over-voltage, under-voltage, reverse phase sequence and differential current conditions.

During the year a high-speed test rig was commissioned for Air-India International. Comprising a 90 h.p., 9,000 r.p.m. motor and gearbox unit, Ward-Leonard motor-generator set, control cubicle and operator's desk, it will be used for testing overhauled Sundstrand constant-speed alternator drive units.

### Hose-end Filtration

HOWEVER much care is taken in the design and manufacture of the filters employed in aircraft refuellers, instances may occur of an unacceptable level of contaminant being present at the nozzle end of the hose. Possible causes are damaged or incorrectly fitted components in the main filter, or fragments breaking away from components further downstream.



*The TurbOmonitor in part section*

To detect and prevent this risk, Automotive Products Co Ltd, of Leamington Spa, offer the TurbOmonitor. Fitted immediately upstream of the nozzle, it consists basically of a very fine (10 micron) wire-cloth filter. If the fuel is clean the TurbOmonitor registers only a very low pressure-drop, but any contamination will immediately cause a drop which will be shown on the flow gauge. In a choked condition the device will allow fuelling to proceed at a reduced rate, but the particle-size cut-off of the filter will ensure that only clean fuel enters the aircraft.

Nominal capacity of the TurbOmonitor is 300 Imp gal/min (a 600gal/min model for use at the vehicle end of the hose is also available); normal filtration pore size is 10 microns, and absolute cut-off 25 microns; overall length of the fitting is 18¾in and weight 8lb; and quick-release connections are for 2½in hose.

The TurbOmonitor is only one item in the range of PurOlator refuelling filtration equipment made by Automotive Products; this range includes bulk-capacity filters and static and vehicle-mounted filter/separators.

## IN BRIEF

The Indian Minister of Industries, Mr Manubhai Shah, recently laid the cornerstone of a new Goodyear tyre and tube plant at Ballabgarh, 20 miles south of New Delhi.

Quality approval has been given for the M4 range of brass plugs and sockets made by Smart & Brown (Machine Tools) Ltd, 25 Manchester Square, London W1. The joint service RCSC approval number is 1348/1.

Mr J. P. Castrey has joined the technical sales staff of Smiths Aviation Division at Kelvin House, Wembley Park Drive, Wembley, Middx. He was formerly with the technical sales department of R. B. Pullin and Co Ltd.

The Firth Cleveland Group have formed a new US company, Firth Cleveland Steels Inc, with offices at 230 Park Avenue, New York 17, NY. It will act as selling agents in the United States for all companies in the steels division of Firth Cleveland.

Automotive Products Associated Group have announced the appointment of Mr A. W. Turner, general manager, as local director of Lockheed Precision Products Ltd, Speke, Liverpool. His responsibilities include the manufacturing and marketing of Lockheed hydraulic aircraft components, industrial hydraulic equipment and Lockheed Avery hoses and self-sealing couplings.

The automatic control division of Constructors John Brown Ltd has been formed into a wholly owned subsidiary company, Automatic Control Engineering Ltd, Roxby Place, Seagrave Road, Fulham, London SW6 (FULham 7761), with effect from January 1. The directors will be Messrs I. J. Crosthwaite, DSO (chairman); H. D. Walker, MIMECHE, MINSTPET; R. Riley, BSC(ENG), ACGI, MIMECHE; H. H. Rosenbrock, BSC(ENG), PHD, MIEE; and M. P. Atkinson, BENG. Mr Riley will hold the position of general manager and Mr Atkinson that of chief engineer.

A booklet describing Hylomar, a universal jointing compound made under licence from Rolls-Royce Ltd to their specification SQ.32, has been published by the manufacturers, Marston Lubricants Ltd, Rock Ferry Oil Works, Birkenhead, Ches. The compound has been developed in the Rolls-Royce laboratories at Derby for use in jet engine production on metal-to-metal joint faces where high pressures and temperatures are encountered and also when the searching properties of jet fuels and lubricants have to be considered.

Transistorized power-conversion systems in spacecraft which include Discoverer and Transit satellites and the Pioneer 5 space probe are among the products of Gulton Industries Inc of Metuchen, New Jersey, who recently announced the formation of a British subsidiary, Gulton Industries (Britain) Ltd, 9 Drapers Gardens, London EC2. Other items developed and made by Gulton include accelerometers and telemetering and data-handling equipment. Many of the company's products contain ceramics, mainly in capacitors, transducers and semi-conductors.

Boeing 720-048s being operated by Irish International Airlines on Atlantic routes have been equipped with Dunlop tyres.

Mr A. Broomhead has been appointed deputy managing director of Thos Firth & John Brown Ltd and Mr F. Wortley, a director of the company, has been made general works manager.

Corrosion resistance is the subject of the latest titanium brochure, *ICI Titanium/3*, published by the metals division of Imperial Chemical Industries Ltd, Imperial Chemical House, Millbank, London SW1.

The propeller brake designed and manufactured by the Dunlop Aviation Division is being used on Vickers Vanguards of BEA. It is stated that the brake, which weighs only 24oz, halts the blades within 20sec of application and can hold them at rest even in a 50kt wind.

The first British national Drawing Office and Equipment Materials Exhibition is to be held at the Royal Horticultural Society's New Hall, Westminster, London SW1, from June 5 to 8. Organizers are UTP Exhibitions Ltd, 9 Gough Square, Fleet Street, London EC4.

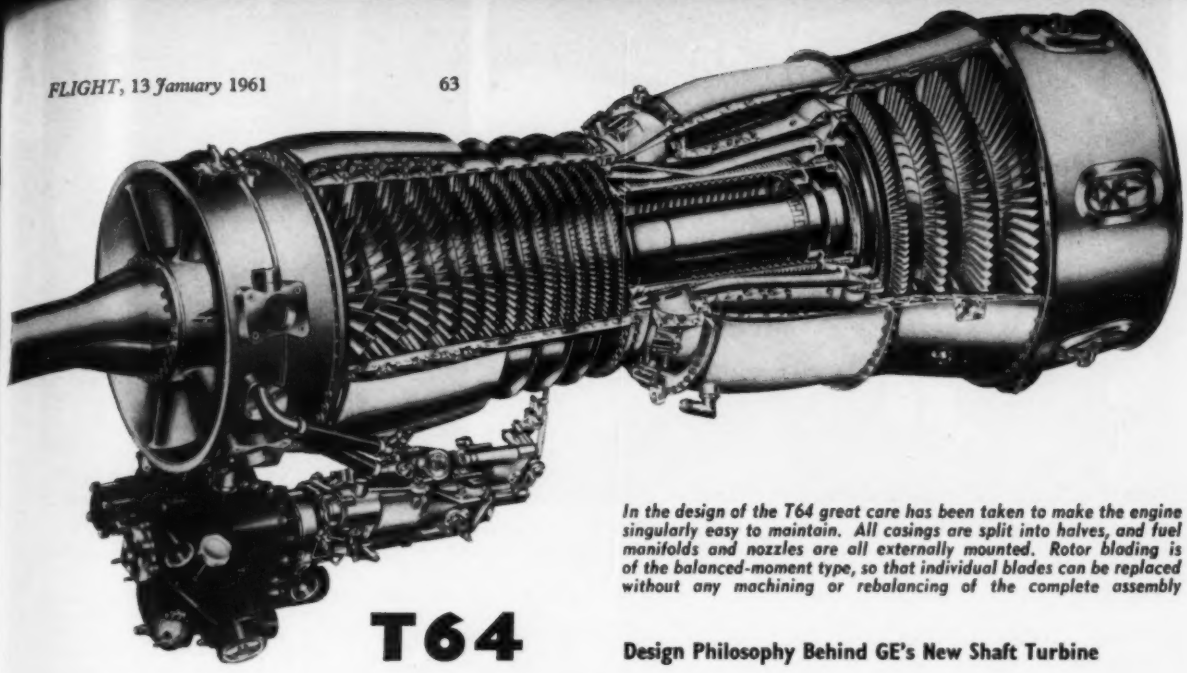
Mr Norman Daniel, assistant general manager for the past 18 months of Semtex Ltd, the Dunlop subsidiary, is taking over the post of general purchasing manager for the Dunlop Group. He succeeds Mr D. J. Flunder, who is taking up a senior position in the tyre division.

Mr E. F. Duncan, AMIEE, has been appointed manager of the accessories division of British Insulated Callender's Cables Ltd, Prescot, Lancs. He was made sales manager of the division in 1959, becoming deputy divisional manager in April last year, and is a director of BICC-Burndy Ltd.

Elliott Bros (London) Ltd have been appointed exclusive representatives in the British Isles for promotion and sales of the Airbrasive unit for cutting and abrading hard, brittle materials. The tool, a product of S. S. White Industrial Division, New York, is available at the Elliott Bros offices, Lewisham, London SE13, for demonstration purposes.

Miniature potentiometers made by Miniature Electronic Components Ltd, The Lye, St Johns, Woking, Surrey, have been specially adapted for aircraft and GW applications. They are now being made in double and triple form to further space-saving. Both the double (Model 062) and triple type (Model 087) are housed in one-piece anodized aluminium cases with two fixing holes, and are available with any combination of ohmic values.

Fifteen employees of the Ultra Group were recently presented with inscribed gold watches to mark 25 years' service with the company. Mr Edward E. Rosen, chairman of Ultra Electric (Holdings) Ltd, remarked at the presentation ceremony that 15 was the largest number of employees to qualify for this special long-service award in any one year. Last year also marked the 40th anniversary of the founding of the original Ultra company.



*In the design of the T64 great care has been taken to make the engine singularly easy to maintain. All casings are split into halves, and fuel manifolds and nozzles are all externally mounted. Rotor blading is of the balanced-moment type, so that individual blades can be replaced without any machining or rebalancing of the complete assembly*

# T64

## Design Philosophy Behind GE's New Shaft Turbine

FOR some years the gas-turbine design policy of the American General Electric Co has been to achieve high pressure-ratio on a single shaft, at the same time obtaining satisfactory handling by the use of variable stators. The first engine to incorporate these principles was the big J79 turbojet, but the company's Small Aircraft Engine Department at Lynn, Mass, is now committed to two families of small turboshaft engines of similar configuration. The first of these is the T58, which has been widely adopted by airframe designers and is being licence-produced by de Havilland Engines as the Gnome.

In 1953 the accepted formula for a small engine presupposed indifferent component efficiencies, low pressure-ratio and modest top temperature. Consequently such engines were poor performers, and compared unfavourably with their piston-engine rivals. It was at this time that the designers at Lynn formed the opinion that something could be done to break a vicious circle: small-engine development was starved of funds owing to low military priority, which in turn stemmed largely from the unattractiveness of the engines themselves. "Surely," they thought, "a small gas turbine can be built with big-engine quality."

Moreover—and this is the crux of the argument—the company's studies showed that such engines, although relatively costly, made sound economic sense. Only a limited market could be envisaged so long as the established piston engines continued to perform their task in a satisfactory manner. Arithmetic showed that a turbine engine of advanced design, fitted in either a helicopter or aeroplane, would enable substantially improved payload/range curves to be plotted on short ranges; but, inevitably, the piston engine came back into the picture above a given endurance; the T58's pressure ratio of 8.3 : 1 was insufficiently high.

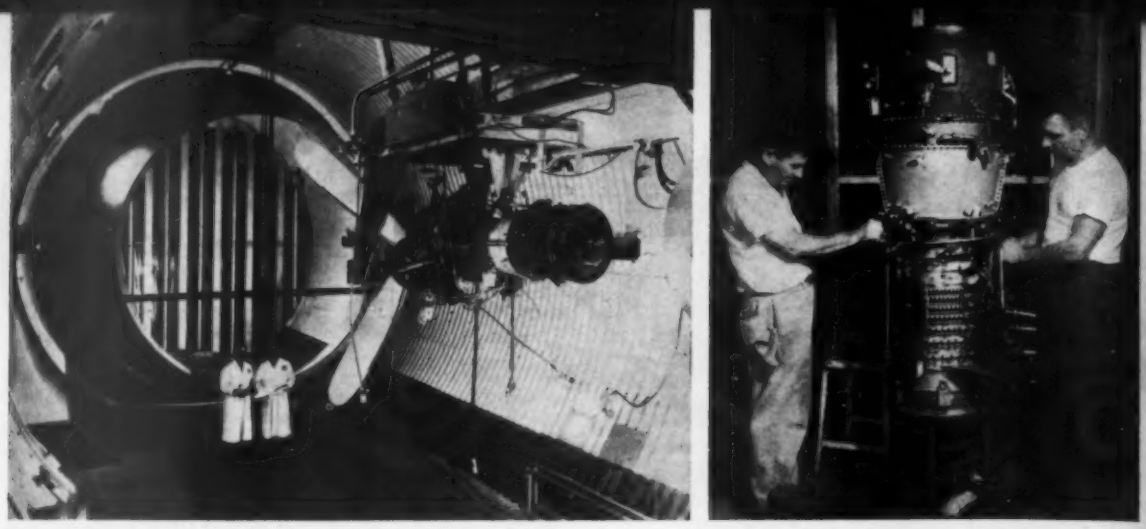
During 1954 work began on a small turbojet, now known as the J85. Emphasis was laid on the achievement of minimum specific weight. It is well known that, if specific weight for a range of theoretical engines with similar parameters is plotted against engine-size, the result is a loop with minimum values in the neighbourhood of 2,000-3,000lb. In the final reckoning installed weight must be considered, and this tends to favour the large engine. On the other hand, GE were able to demonstrate that a small engine can be produced with overall quality comparable to that of a large engine. For example, while the T58 was on the drawing board many engineers doubted that the compressor efficiency would exceed 78 per cent; but the production compressor surpasses 85 per cent. Bearing in mind that the blades in the final stages are smaller than the average thumbnail, this is a remarkable achievement. The centre bearing holds clearances adequately, blade chord is a maximum (and costs nothing) and advanced rolling and coining methods have been evolved for rapid and relatively cheap production. By 1956 the T58 was well into its bench tests, and several helicopters were being prepared to use it. In each case the airframe designer had concurred with GE's contention that the engine should be assessed as part of an integrated transport system. In the ultimate equation regarding the number of vehicles required to fulfil the operator's task, the employment of a lighter and more efficient engine became of supreme importance; particularly in the helicopter world, every ounce of weight saved was found to have a measurable effect on overall economics.

Such was the climate surrounding the basic design of the T64 in the winter of 1953-54. Teams from Lynn were touring the American airframe industry, and their studies showed that, while the T58 turboshaft engine and J85 turbojet were both correctly sized and timed, there was an increasing need for a shaft machine rated at some 2,500 h.p. with the highest possible thermodynamic efficiency. A competition for such an engine was held by the US Navy, and after an early closure GE were announced a winner and went ahead on preliminary design during 1954.

Perhaps the most basic parameter in the design of any gas turbine is compressor pressure-ratio. As this is raised above 12 : 1 the losses must increase disproportionately; and at the same time additional turbine stages have to be brought in, causing a substantial increase in powerplant weight. For an appreciable period GE pursued a 2,500 h.p. study with five turbine stages; but, while this was regarded as a promising "growth" engine for future development, it was decided that, having due regard for the law of diminishing returns, the correct choice for the initial product would be a lighter engine with a total of four turbine stages (two compressor and two power). Time of flight, always an important factor in engine design, was clearly going to exceed by a wide margin that of the many aircraft using the T58. None of the applications envisaged could approach sonic speed, so that a high inbuilt pressure-ratio could not prove an embarrassment. Moreover, the fact that most of the applications involved expensive aircraft made engine cost relatively less important. Curves for specific fuel consumption were plotted against aggregate engine-plus-fuel weight for a range of missions. It was clear that the weight of the propeller, gearbox and turbine would be much greater than that of the compressor, and that in any case the weight increase consequent upon raising the pressure-ratio (near the point at which an additional turbine stage became necessary) would be relatively insignificant. Altogether the calculations showed that the weight-penalty of a high pressure-ratio was well worth paying.

Accordingly it was decided to choose a pressure ratio of 12.5 : 1, the highest yet adopted in any single-spool turboshaft engine. In order to achieve the desired level of 2,500 h.p. the mass-flow was fixed at 25lb/sec. Immediately these figures were established, component evaluation was put in hand. Power is a function of airflow, temperature and component efficiency (in that order), with a high pressure-ratio giving a small bonus. During 1954 and 1955 GE took the project "down the road" without waiting for any further competition. Early in 1956 the company made an unsolicited proposal to the Navy, pointing out that the engine would suit complete families of aircraft, including many types already in production with piston engines. It was emphasized that its adoption would actually return money to the taxpayer, owing to the much-increased capability of helicopters and fixed-wing aircraft and the consequent reduction in the number of vehicles required. "For the first time in history," said GE, "it would become an economic proposition to start junking new piston engines."

Independently the Navy had been making their own investigations, and concurred with GE's claims. A competition for the T64 was thereupon initiated, and after almost a year GE were declared the winners, and an instruction to proceed was received early in 1957. The contract was of the cost-plus-fixed-fee type; valued at $58m, it covered the development up to 150hr qualification of turboprop, turboshaft and direct-drive engines, in both



*Turboprop T64s are being run in the new cell at Lynn referred to in the accompanying text; the -4 is shown on test, but there is also a -8 with propeller shaft above the centreline instead of below. On the right, engineers at Lynn are assembling a fully instrumented gas-generator*

## T64 . . .

single and twinned configurations, all using the same gas generator. This is unique.

There was never any doubt in the company's mind that the free turbine is safer than the single-shaft formula, and for shaft-drive units they regard it as essential that the power turbine and all portions of the compressor should be completely disengaged. Such an arrangement increases the flexibility of the propulsion system, and enables optimum engine and rotor (or propeller) r.p.m. to be matched at all times. In planning the turbine assembly of the T64 care was taken to achieve a fairly flat efficiency curve over an adequate range of rotational speeds. A cycle was then picked which permitted the 2+2 type of turbine.

With regard to the combustion system, the company had previously achieved success with truly annular designs on the T58 and J85 and regarded such chambers as essentially sound. In the T64 the inner liner and flame-tube consist of upper and lower halves, either of which may be removed without disturbing the hot end of the engine. The split combustion chamber was not part of the original scheme, but was incorporated in a second batch of test engines. Already liners have been dismantled without removing the engine from the stand.

This is one of numerous instances in which the detail engineering has been planned to give the engine maximum accessibility and ease of maintenance. For example, even when the engine is installed, the compressor casing can be unbuttoned and any required blade may be slid from the casing or rotor without further ado. Another example of this practice is found in the turbine section, where again the casings are split. During development this has been found a great asset, in that it permits the diaphragm openings for a given set of wheels to be optimized while the engine remains *in situ*.

Having established the design of the gas-generator, GE went on to evolve gearbox systems for the turboshaft and turboprop versions. In both cases the boxes are self-contained assemblies which may be replaced with minimum disturbance to the front end of the gas-generator. In the turboprop version the gearbox is carried remote from the intake in an arrangement superficially similar to that adopted by Allison for the Model 501. Engine accessories are hung beneath the compressor and driven from the front end of the gas-generator, and the aircraft units are attached around the rear of the reduction gearbox. Provision is made for electric or other means of shaft-power starting, but at the present time it appears likely that most carrier-based aircraft using the T64 will have an air-impingement starter operating on the first-stage turbine. Use of such a starter has been found a great help during the development of the gas-generator, since the latter can be motored gently on the air blast alone.

GE have with their own funds constructed a unique test stand at Lynn, in which is being conducted the development of the T64-4 turboprop. It is constructed from corrugated steel conduit, without any subsidiary structure; in previous test cells of this nature corrugated sheets have been employed only as a forme for a reinforced-concrete cell. The new construction is still partly experimental, but it is working well and seems to have cost roughly half as much as the previous method. As the left-hand photograph above shows, the turboprop is suspended from the roof and all feed and instrumentation lines are grouped in an axial trunk along the upper part of the cell. The cell orifice is mounted on a track, and orifices of different sizes permit this parameter to be matched to the size of the propeller employed. At present a 14ft Hamilton Standard propeller is being used, with four blades. During early runs strain-gauges were fitted to an average of two blades in each stage of the compressor. By this means "live" blades could be tracked down before the blade settings were frozen. This work was first conducted on the T64-2 turboshaft engine, and was then transferred to the -4 to investigate the effect of the propeller upstream of the intake.

Although the qualification date for the turboshaft engine is ahead of that of the turboprop, the latter ran first, in January 1959, the output power being absorbed by a dynamometer. The -2 followed in March, and the guaranteed powers and s.f.c. have both been surpassed, as the data tables show. An unusual contract requirement is a stipulation for endurance testing. GE will have completed 10,000hr of cell running before the first engines are shipped in a few weeks' time. Sheer hours mean little, since excessive consumption of this commodity during certification testing may merely reflect the incompetence of the manufacturer; GE feel that any contractor worth his salt should pass all 150hr qualification tests on a new engine well inside the 10,000hr mark.

Included in the contract is finance for "a substantial number" of development engines—certainly more than 30. Some of these have been selected for repeated 1,000hr endurance testing. Other engines are running with inlet ducts from two airframe manufacturers, with excellent results. One T64 has spent two winters on Mount Washington ingesting up to 2.1gm/m³ of water at 5°F while preventing ice formation—even at ground idle—without tapping more than 0.7 per cent of bleed air. Last September an engine started environmental tests at the Navy engine laboratory in Philadelphia. All running has been on JP.4 or JP.5.

First delivery is scheduled for early this year, when a pair of YT64-GE-4 turboprops are due to be shipped on a 50hr basis to de Havilland Aircraft of Canada for installation in a Caribou. This aeroplane is regarded by GE as an ideal test-bed for the fixed-wing T64s. Only one firm application of the engine has so far been announced: Sikorsky have stated that a switch to the T64 in the S-60 twin-engined crane helicopter will permit the payload to be increased by two-and-a-half times. But this does not mean GE have backed the wrong horse; a recent check showed that American airframe manufacturers have, as active projects: T64-powered cargo helicopters, an assault helicopter, a crane (the S-60/64 series), VTOL vehicles, STOL assault transports, carrier-based ASW vehicles, executive transports, "long-endurance aircraft" and ground-effect vehicles.

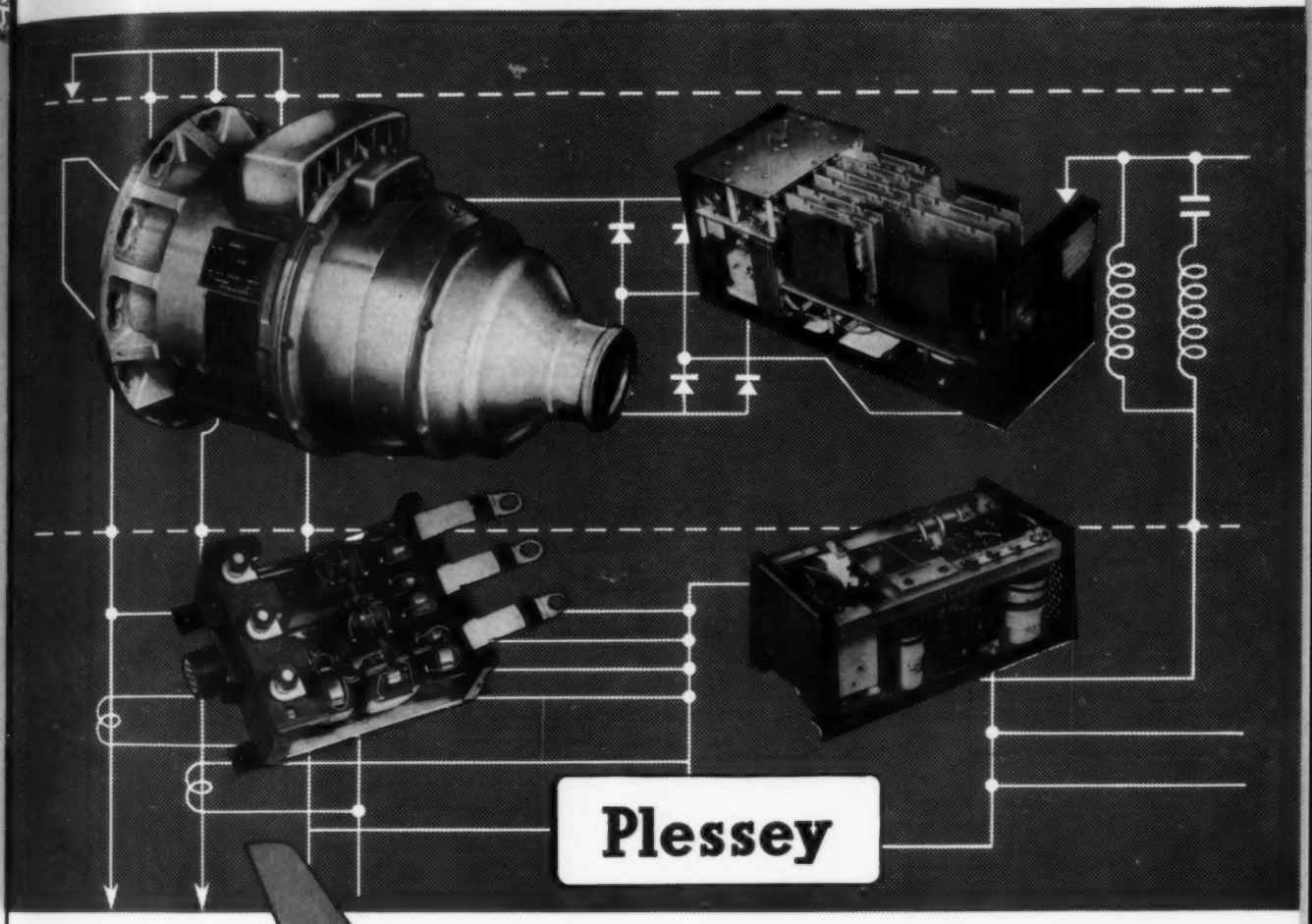
W.T.G.

**T64 DATA**

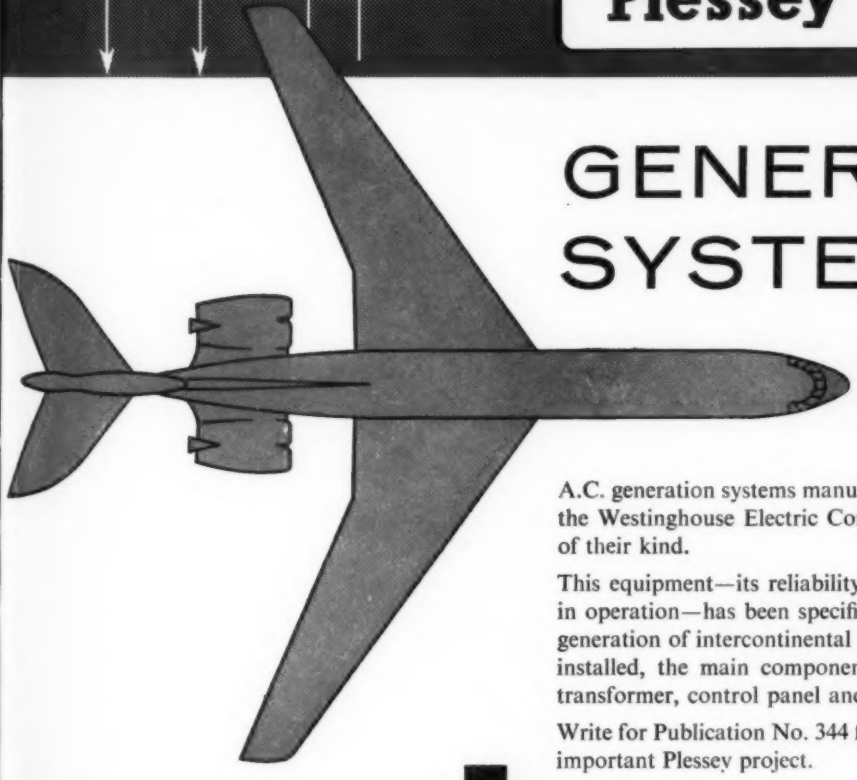
| | | | |
|---|---|---|---|
| Compressor stages | 14 (four variable stators) | | |
| Turbine stages | 2+2 | | |
| Max. mass flow | 24.5lb/sec (original figure, 25) | | |
| Max. pressure ratio | 12.6 : 1 (original figure 12.5) | | |
| Max. compressor r.p.m. | 17,000 | | |
| Max. output shaft r.p.m. | 13,600 | | |
| | **T64-2 turboshaft** | **T64-4 turboprop** | **T64-6A direct drive** |
| Reduction gear ratio | 2.61 : 1 | 11.8 : 1 | — |
| Max. output r.p.m. | 5,200 | 1,160 | 13,600 |
| Length | 91in | 113in | 68in |
| Height | 30in | 36in | 30in |
| Weight | 854lb | 1,079lb | 700lb |
| Guaranteed military s.h.p. | 2,650 | 2,700* | 2,650 |
| ,, ,, s.f.c. | 0.506 | 0.495 | 0.506 |
| Achieved military s.h.p. | 2,780 | 2,760* | 2,780 |
| ,, ,, s.f.c. | 0.490 | 0.483 | 0.490 |
| Guaranteed 85% rated s.h.p. | 1,897 | 1,982* | 1,897 |
| ,, ,, s.f.c. | 0.552 | 0.530 | 0.552 |
| Achieved 85% rated s.h.p. | 2,065 | 2,150* | 2,065 |
| ,, ,, s.f.c. | 0.537 | 0.513 | 0.537 |
| First official run | Mar. 1959 | Jan. 1959 | Mar. 1959 |
| 50hr prelim. flight rating | April 1960 | May 1960 | April 1960 |
| 150hr qualification | Aug. 1961† | Dec. 1961† | Aug. 1961† |

* e.h.p.; † contract date (other dates were two months ahead of contract).

Another **Plessey** contribution to a.c. techniques




# GENERATION SYSTEMS



A.C. generation systems manufactured by Plessey under agreement with the Westinghouse Electric Corporation, USA, are the most advanced of their kind.

This equipment—its reliability and all-round advantages fully proven in operation—has been specified for the Vickers VC 10, BOAC's next generation of intercontinental airliners. Four 40 kVA channels will be installed, the main components of each channel being a generator, transformer, control panel and voltage regulator.

Write for Publication No. 344 for more information about this new and important Plessey project.

*For qualified engineers interested in working on advanced equipment of this type, the opportunities at Plessey are outstanding. Please write to the Personnel Officer.*

**Aircraft & Atomic Energy Group · Aircraft Electrical Division**
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## Forty flying years

Albert Plesman founded KLM in 1919. The Royal Dutch Airline is thus the oldest-established of international operators, and pathfinder of many well-used world routes, especially to and through the Far East. Today, KLM flies DC8's through to Australia over trails blazed in part by Plesman's pioneers.
At Sydney AIR BP fuels KLM's new aircraft with the speed and precision that new jet turn-round schedules demand.

*Fast flying* KLM ROYAL DUTCH AIRLINES *... fast fuelling* AIR BP

# AIR COMMERCE

*Delivered to Pakistan International Airlines at Schiphol on January 3 was the first of five Fokker Friendships for this operator. Four will be 40-seat airliners and one a Freightship with the large cargo door. Passenger services will be inaugurated on January 23*

## GHANA'S STATUS SYMBOL

THOUGH Ghana Airways is still a BOAC associate, with BOAC Associated Companies holding 40 per cent of the £400,000 nominal capital, the seven-year agreement signed between the two airlines in July 1958 is being revised. Soon the airline will not be a BOAC associate. This is a reflection of Dr Nkrumah's desire for the minimum of foreign influence in Ghana's affairs, and of his regard for the nation's airline as a symbol of Ghana's national adulthood.

Ghana gave notice a year ago (*Flight*, January 22, 1960) that she intended to buy out BOAC Associated Companies' 40 per cent interest, and the corporation agreed to revise the contract accordingly. No date has been fixed for the actual transfer, and for the time being Sir Duncan Cumming and Mr Desmond Bungay remain as BOAC's representatives on the board.

The revenue pool between BOAC and Ghana Airways on the UK - Ghana route has also been revised, taking into account the fact that Ghana Airways now owns (rather than charters from BOAC) Britannias. It is understood that though the operation of these two aircraft is by BOAC crews, these are under contract to Bristol in accordance with the terms of the contract between Ghana Airways and Bristol.

BOAC have 12 staff seconded to Ghana Airways under the seven-year agreement, and there appears to be no intention on the part of Ghana to rescind this part of the contract. BOAC have the following staff in Accra: Mr L. C. Giles, acting general manager; Mr J. W. S. Gregson, station manager Accra; Messrs K. G. A. Bond and J. W. Seares, accountants; Mr B. Thomsett, reservations superintendent; Mr F. Ives, reservations officer; Mr R. F. Muir, sales superintendent; Mr G. H. Langtrey, senior station officer; Mr J. S. Burley, station officer; and Mr L. Stevens, engineer. All these staff are on one- or two-year tours, and presumably they will continue at their posts, or be interchangeable with other BOAC staff, for the full term of the BOAC - Ghana Airways agreement. Two others are based in London.

Meanwhile BOAC, also in accord with the agreement, are training Ghanaians to complete the "Ghanaization" of the airline (*Flight*, March 4, 1960, page 322). There are at the present time no fewer than 70 Ghana Airways people in the UK under BOAC training or taking courses elsewhere, and a further 30 are expected during the next few months—the eventual total, it is believed, being likely to rise to 112. These trainees include all Ghana Airways senior management and executives, such as the prospective general manager, chief pilot, chief engineer, chief accountant, and so on.

A recent article in *Aviation Week* attributes to Ghana officials the admission that Ghana Airways "is not a commercial operation and isn't trying to be one," and that the idea is to make Ghana Airways the dominant carrier of an independent Africa. According to this American source, "BOAC officials who run the airline under a management contract maintain a pained silence when questioned on how the carrier [which has bought Britannias, Il-18s, Viscounts and is shopping for 707s or VC10s] plans to operate a fleet of aircraft flown by British and Russian pilots and maintained in London and Moscow." It notes that BOAC management personnel "find themselves committed to run an airline whose important equipment and route decisions [including the decision to buy Il-18s, which are Soviet-crewed and maintained] are often made without their knowledge. And if the whole costly operation collapses some day, it is only natural to expect the Ghana Government to put the blame on the BOAC management."

Last week a BOAC spokesman declined, naturally enough, to comment on these statements. But it is believed that BOAC have in fact warned the Ghana Government of the financial consequences of the prestige policies being pursued. BOAC will soon have no financial stake in Ghana Airways, which in any case has always had its losses under-written by the Ghana Government, but the corporation finds itself shouldering more than a mere contractual obligation to make Ghana Airways a success.

## BLACK BOX BOOKING BY BEA

THE ideal airline reservations system should (1) give a quick answer to all booking inquiries; (2) avoid overbooking and underbooking, and hence achieve the optimum load factor on each flight; (3) keep an accurate record of the source and scale of demand; and (4) keep a check on bookings so that the traffic department can be kept in the picture.

Going are the days in most big airlines when haphazard "stop-sale" messages are sent out to reservations centres. And going too are the days when, at widely distributed booking points, all ticket-sales are entered on slips and big boards are manually adjusted to show clerks which flights are full or open. Even the improvement on this method—the replacement of slips and boards by sheets stuck on big rotating drums (or moving belts) with clerks sitting around them—is being quickly outdated by rising traffic; there are limits to the expansion of sight boards, if only because of the eyesight limitations of booking clerks, some of whom are finding that they need binoculars to read the sight boards.

Nowadays the booking of airline tickets by a big airline—that is to say one carrying three or four million passengers a year—must be as automatic as possible. A system is needed whereby the telephonist-clerk, on receiving an enquiry, can just slip a key-coded card into a box which interrogates a computer which in turn replies with lights to say whether the flight concerned is open or full. American Airlines have had such a machine, known as the Reservisor, for ten years, and a "sophisticated" development for four years. It works day and night non-stop for months on end, and it is known as "fully integrated electronic booking."

Now BEA, who in 1960 carried 3,860,000 passengers, are to buy such a computer (though they decline to say from whom). It is to be installed at their Cromwell Road air terminal in 1963 at a cost of about £2m for the computer plus a further £2m for the complete system. This seems expensive; but if the system manages to raise BEA's load factor for a given standard of service by only one per cent, it will (on our estimate anyway) have paid for itself at BEA's rate of earning revenue in four or five years—by about 1967 or 1968.

*One of the few occasions on which the chairmen of the two airways corporations have been seen together in public was at the National College of Air Training at Hamble last week. On the left is Capt J. W. G. James, flight operations director of BEA.* *A note about the occasion is on page 69*

## AIR COMMERCE . . .

# 1960 Safety Record

A TOTAL of 1,226 occupants of commercial transport aircraft, scheduled and non-scheduled, lost their lives during the year 1960. The adjacent table, *Flight*'s third annual compilation from *Lloyds' List* of aircraft casualties, is provisional only, and a full assessment of the 1960 scheduled-service safety record must await publication of official ICAO statistics; but some tentative conclusions can be drawn. Marked * are those accidents which we believe, in the absence of more information, to have occurred on scheduled services—though it is possible that some of the accidents not thus marked were also on scheduled services.

At a conservative estimate, at least 830 passengers were killed on scheduled services during the year. This is over 200 more than the losses in 1959 (625) and 1958 (629). The fatality rate per 100m passenger miles, 1.2 for ICAO over the past five years, was probably more than 1.2 in 1960. We use the word "probably" because not only is the figure of 830 scheduled fatalities provisional, but the ICAO estimate of 1960 passenger miles—69,000m—is also provisional.

At an *optimistic* estimate (i.e., assuming 830 passenger fatalities and not less than 69,000m ICAO scheduled passenger miles), the 1960 fatality rate was 1.2, about the 1955-59 ICAO average. At a *pessimistic* estimate (i.e., assuming a possible maximum of 900 scheduled passenger fatalities and less than 69,000m passenger miles) the 1960 ICAO rate could have been as high as 1.3.

It is almost certain that the world air transport fatality rate for 1960 in fact showed an upward trend. Historians may look back and say: "Ah yes, but wasn't 1960 the year in which the big jets came into full operation, and hadn't it always been predicted that these aircraft would lower the safety rate?" But a glance through the table on this page shows that there was only one accident involving a big jet, the DC-8 that collided with a Constellation on December 16. And out of an estimated 27 accidents to scheduled services, ten involved turbine aircraft, of which only three could reasonably be ascribed to a fault in the aircraft.

It is a sobering thought that if ICAO traffic increases in 1961 at the same rate as last year, and the fatality rate remains at an optimistic 1.2, then nearly 1,000 passengers are going to be killed this year on scheduled services.

| Date | Carrier | Aircraft | Location | Fatalities Pass. | Crew | Circumstance |
|---|---|---|---|---|---|---|
| Jan 6 | National* | DC-6B | Bolivia, N. Carolina | 29 | 5 | Sabotage |
| Jan 18 | Capital* | Viscount | Holdcroft, Virginia | 46 | 4 | Mechanical failure? |
| Jan 19 | SAS* | Caravelle | Ankara | 35 | 7 | Hit hill on approach |
| Jan 21 | Avianca | Super Constellation | Montego Bay | 37 | | Heavy landing |
| Jan 27 | Transportes Aereos de Timor* | Heron | Timor Sea | 7 | 2 | Unknown |
| Feb 5 | Lloyd Aero Boliviano* | DC-4 | Cochabamba | 55 | 4 | Take-off |
| Feb 25 | REAL* | DC-3 | Rio de Janeiro | 30 | | Mid-air collision with US Navy DC-6 |
| Feb 26 | Alitalia* | DC-7C | Shannon | 19 | 11 | Take-off |
| Mar 16 | All Nippon Airways* | DC-3 | Komaki Airport, Nagoya | 2 | 1 | Collision with jet on landing |
| Mar 17 | Northwest* | Electra | Tell City, Indiana | 57 | 6 | Mid-air disintegration |
| Mar 20 | Sociedad Aeronautic Medellin | C-46 | Medellin | 25 | 3 | Forced landing with engine trouble |
| Mar 20 | Colombian Aido Canso | Amphibian PBY-5A | Eastern Colombia | 4 | 2 | Crash landing |
| Apr 5 | Lineas Aereas de Nicaragua | C-46 | La Luz Mine Airport | 3 | 1 | Unknown |
| Apr 12 | Varig | DC-3 | Location uncertain | 5 | | Burst tyre on landing |
| Apr 20 | Lloyd Aero Colombiano | C-46 | Bogota | 31 | | Crashed on approach |
| Apr 22 | Sobelair | DC-4 | Mt Bogora, Congo | 28 | 7 | Flew into mountain |
| Apr 28 | Linea Aeropostal Venezolana* | DC-3 | Calabozo Airport | 8 | 2 | Sabotage |
| May 3 | Navegacao Aerea Brasileira | C-46 | Ramey AFB, Puerto Rico | 5 | | Forced landing with engine trouble |
| May 15 | Balair | DC-4 | Jebel Marra Mt, Sudan | 2 | 10 | Believed hit mountain |
| May 19 | Air Algerie* | Caravelle | Paris Orly | 1 | — | Mid-air collision |
| Jun 10 | TAA* | Friendship | Mackay, Queensland | 25 | 4 | Unknown |
| Jun 15 | Pacific Northern | Constellation | Mt Gannett, Alaska | 9 | 5 | Crashed into mountain |
| Jun 25 | REAL* | Convair 340/440 | Rio de Janeiro | 48 | 5 | Following diversion |
| Jun 27 | Lineas Aereas Costaricanses | DC-3 | Between San Jose and Los Chiles de Grecia | 1 | — | En route |
| Jul 10 | Kalinga Air Lines* | DC-3 | Between Bahrein and Doha, Qatar | 16 | 4 | En route |
| Jul 14 | United States mission to Colombia | DC-3 | Pichincha Mt, Ecuador | 18 | | En route |
| Jul 21 | Deutsche Flugdienst | Convair | Rimini | 1 | — | One-engine landing |
| Jul 28 | Chicago Helicopter Airways* | S-58 | Chicago | 11 | 2 | Structural failure? |
| Aug 24 | Don Everall | Viking | Crete | — | 3 | Take-off |
| Aug 28 | Air France* | Super Constellation | Dakar | 55 | 8 | Approach |
| Sept 7 | Aerolineas Argentinas* | DC-6 | Salto, Uruguay | 25 | 6 | Sabotage? |
| Sept 18 | World Airways | DC-6B | Guam Island | 78 | | Take-off |
| Sept 26 | Austrian Airlines* | Viscount | Moscow | 25 | 5 | Approach |
| Sept 28 | Mexicana* | DC-3 | Mexico | 5 | | Landing |
| Sept 29 | Misrair* | Viscount | Between Geneva and Rome | 17 | 6 | En route |
| Oct 4 | Eastern Air lines* | Electra | Boston | 61 | — | Take-off |
| Oct 14 | Itavia* | Heron | I. of Elba | 11 | | En route |
| Oct 28 | Northwest* | DC-4 | Montana | 12 | | Crashed into mountain |
| Oct 30 | Arctic-Pacific | C-46 | Toledo, Ohio | 20 | 2 | Take-off |
| Nov 5 | Royal Nepal Airlines | DC-3 | Bairihawa | — | 4 | Take-off |
| Nov 7 | AREA* | F-27 | Quito | 37 | | Crashed into mountain |
| Nov 23 | PAL* | DC-3 | Manila | 28 | 4 | Take-off |
| Dec 12 | Air Lines of NSW | DC-3 | Sydney | — | 3 | Crashed in sea |
| Dec 7 | REAL | Commando | Cachimbo | 15 | | Crashed |
| Dec 16 | TWA / United * | Super Constellation / DC-8 | New York | 37 / 76 | 5 / 7 | Collision |
| Dec 22 | PAL* | DC-3 | Cebu | 26 | 2 | Take-off |
| | | | | 802 | 284 140 | |

Total passenger and crew fatalities in 1960: 1,226

*Scheduled services.

## WEBBAIR'S X-Y LICENCE

DIFFICULTIES with which the Minister of Aviation has been confronted in specifying air service licences for every type of operation are illustrated by the case of Webbair.

This organization arranges closed-group charters to European motor races on an inclusive tour basis, but their operations are not exactly defined by either the X (closed-group) or Y (inclusive-tour) transitional licences issued by the ATAC. The company claim to be the first operator to have applied for a closed-group licence of this nature before the closing date (June 23) and they are the first to be awarded a transitional licence, effective for a year, to continue this type of operation. While they have yet to be awarded a Class D licence by the Air Transport Licensing Board, which has yet to start its hearings, Webbair claim that the award of a licence to them is significant in view of the effect of the Civil Aviation (Licensing) Act in restricting non-scheduled and closed-group flying to airlines with a high standard of maintenance and proven resources. Webbair flights are conducted by Silver City Airways and by Dan-Air and are open to any member of six months' standing of any British motor club, together with his immediate family. During 1961 the organization is to operate at least 32 inclusive excursions to European grand prix and sports car events, and dispensation has been granted in the licence so that Webbair may profit from the operation. It will be recalled (*Flight*, July 29, 1960) that a group charter service licence specifies that for affinity groups "the operator's reward" shall not be less than the aggregate amounts paid by the passengers, thus eliminating middlemen.

## LORD TERRINGTON

IT is with great regret that *Flight* records the death on January 7 of Lord Terrington, chairman of the Air Transport Licensing Board. He was 73.

His death comes, unhappily for British air transport, at the moment of the demise of the Air Transport Advisory Council (of which he was chairman since its inception in 1947) and as he was just about to take up his duties as chairman of the new Air Transport Licensing Board.

We recall writing of Lord Terrington, when suggesting names for the new ATLB (*Flight*, February 5, 1960, page 192); "We can think of no better chairman than Lord Terrington, whose diplomacy, knowledge of the law, and understanding of the essentials of the air transport industry are universally respected."

## DANAIRFARES

FARES on Dan-Air Service routes between Bristol or Cardiff and Liverpool have since January 1 been reduced from £5 3s to £3 18s for the single journey. A less marked reduction is apparent in the yearly return fare, since Dan-Air (like BEA) have now abandoned promotional discounts on long-period returns, which are now double the single fare. Three return Dove flights a week to Newcastle have been included in the network since January 2 and the single fare from Bristol or Cardiff on this route is £5 6s. Dan-Air have also applied to operate later this year to Dundee.

Announcing the 1961 fares, Mr F. E. F. Newman, the company's chairman, said that the reductions would have been larger had the MoA not just increased landing charges: "Since we understand that municipally-owned airports such as Bristol will be putting up their charges too, we have been forced to take likely increases into account."

## VOTE FOR HARROWBEER

A REFERENDUM on local affairs is unusual in this country. But on January 5 the 138,240 members of the Plymouth electorate had the opportunity to vote on the choice between renovating and extending a disused wartime airfield or making do with a small grass airfield which it would be uneconomic to try to develop.

Harrowbeer, the wartime airfield, was built on common land at Yelverton, about eight miles out of Plymouth, during 1941. It has two runways respectively 3,320ft and 3,940ft long, but the buildings were demolished in 1951. The civil field continued to be Roborough, which has a 3,200ft maximum run.

In October 1960 the Plymouth County Council voted for the adoption of Harrowbeer as the future civil airport. The estimated cost of repairing the two runways was given as £140,000, with an extra £42,000 as the cost of extending the longer runway by just over 1,000ft. These figures appear surprisingly low.

Introduced in November was the Plymouth Corporation (Harrowbeer Aerodrome) Bill, and on December 13 a public meeting was held and the proposal was carried by 286 to 137. Opponents of the scheme were not deterred by this; under the Local Government Act a formal petition signed by 100 ratepayers is sufficient to require the verdict of all. Many more than the minimum signatures were collected and as the referendum date approached Plymouth looked as though a local election was imminent, posters inviting the electorate to "Put Plymouth on the Air Map." The opposition commented in no uncertain terms on the magnitude of the estimated annual loss (£5,000-£38,000), all of which would have to come from ratepayers.

At the polls last week the council gained a decisive victory. In a ten per cent poll 9,277 votes were cast for the acquisition of Harrowbeer to 4,807 against.

## BAHAMAS AIRWAYS ALL BOAC's AGAIN

DURING the past two or three years the policy of BOAC, following the formation of BOAC Associated Companies Ltd, has been to dispose of subsidiaries rather than to acquire new ones. It is therefore surprising to hear that the corporation has bought back from Messrs Eric Rylands and David Brown the 80 per cent interest bought from BOAC early in 1959.

Questioned in March of that year by the Select Committee on Nationalized Industries about BOAC-AC's policies, Sir George Cribbett said, in the context of Bahamas Airways, that he did not think that the company had ever contributed much to BOAC's commercial results, though it had no doubt contributed substantially to the economy of the Bahamas.

"We have managed," he went on, "to sell out to Skyways and David Brown 80 per cent of our interest in this company, leaving us with a 20 per cent interest, which is sufficient to safeguard our interests." Asked why Skyways and Mr David Brown were prepared to buy BOAC's 80 per cent if Bahamas Airways had been operating at a loss, Sir George said that this was because they believed that they would be more capable of getting Bahamas Government subsidies. Asked why he believed that Skyways would be more influential in the Bahamas than BOAC, Sir George thought this was rather a difficult question to answer, and the minutes of the evidence that followed appear as ****. In the event, the expected inter-islands-routes subsidy was not forthcoming.

*When HRH Princess Margaret and Mr Antony Armstrong-Jones travelled to Shannon at the end of last month it was the first occasion on which members of the royal family had travelled by Aer Lingus—on a Viscount 808 scheduled service. The Princess and her husband returned to London last Monday on a Boeing 720, which was to make its first commercial London - Dublin flight on the same day*

The new Bahamas Airways introduced in February 1960 two luxuriously appointed ex-Skyways Hermes 4s on the routes from Nassau to Miami, Fort Lauderdale and West Palm Beach, with DC-3s operating other sectors. At the same time Eagle Airways (Bahamas), now a Cunard Eagle subsidiary, opened competing services with Viscounts on the Miami route. These, it is understood, are going well and making money, though of course Eagle is not burdened by inter-islands social services.

In a statement last week BOAC said: "In the past 12 months the traffic to and from the Bahamas has increased by more than 100 per cent, but we feel that its feeder line value is no longer assured to us. The company was losing money, and if it had been allowed to lapse its operating licence would also have been lost."

Air Cdre G. J. Powell has been appointed chairman and managing director of the new Bahamas Airways and Sir George Roberts remains president and Mr James Vick general manager.

## BEA BRITANNIAS TO PARIS

THE prospect of a shortage of capacity next summer has led BEA to open negotiations with BOAC for the charter, with flight crews, of two Britannia 102s for three London - Paris daily round-trips in June, and four in July and August. They may be needed in April and May too.

By next summer BEA will have all six of their Vanguard V.951s and up to four of their fourteen V.953s. Even so a shortage of capacity is expected, and this will be aggravated by BEA's training requirements. This will not be the first time BEA have chartered Britannias for the Paris route: some services were operated over the Christmas holiday.

## BUA VISCOUNTS TO LAS PALMAS

THOUGH British United Airways has been operating its West African Safari services through Las Palmas for some years (until last year either as Airwork or Hunting-Clan) it has never been able to obtain from the Spanish authorities traffic rights between London and this popular tourist centre.

At last this permission has been received, and on March 5 BUA are to start with Viscounts the first-ever direct air service between London and Las Palmas. Initial frequency will be once-weekly, the aircraft leaving Gatwick on Sunday evenings and returning on Monday mornings. Tourist return fare will be £82.

*TAA is now operating helicopter services with this Hiller 360 between Australia's first heliport on the Yarra River, Melbourne, and Essendon Airport. No bulk fuel can be stored at the heliport, which is 40ft square and is supported on two large floating pontoons, so helicopter refuelling is carried out by Air-BP at Essendon*

## AIR COMMERCE...

*SAS are one of the few major non-US airlines whose colours have never adorned the Viscount—at least not until the Scandinavian airline chartered two 48-seat 779s from Fred Olsen for domestic services*

### FINLAND'S DAY OF MOURNING

FLAGS in Finland were flown at half mast on January 3 following an accident to an aircraft of Aero O/Y (Finnair). It was the airline's first fatal accident since 1941 and the third since its foundation in 1923. There were no survivors. The accident occurred to a DC-3 on a flight between Kokkola and Vaasa while attempting to make a forced landing near Vaasa. After circling low over a forest the aircraft crashed near the village of Maja and burst into flames, killing all 22 passengers and the crew of three.

According to reports from Finland, radio contact with the DC-3, OH-LCC, was lost five minutes before the crash. Unconfirmed eye-witness reports say that the aircraft was burning when it attempted to land.

### HERALD FOR CHARTER

THE offer of a 44-seat Handley Page Herald for a series of charters or for single flights was made in a recent advertisement in *Travel Trade Gazette*. The company concerned was The Consolidated Netherlands Coach & Aircraft Charter NV of The Hague, Holland, and the advertisement raised a minor mystery as to the Herald's ownership.

The aircraft in fact is that for which an order has been placed by North-South Airlines of Yeadon Airport (*Flight*, November 25, page 832). Although the order for this aircraft has not yet been announced by Handley Page the airline say that it is quite firm and that they expect to take delivery in April. They add that they were asked by The Consolidated Netherlands Coach & Aircraft Charter NV, one of their Continental agents, if the Herald could be offered for charter on the Continent. The Dutch company is a new one, with British and Dutch directors and is associated with travel agencies in this country. Up to the end of last week no firm arrangements had been made for charter of the Herald but the offer still remains open.

### CRISIS HEIGHT AT EMBAKASI

"HOW critical is critical height?" might be regarded as the theme question of the four-day inquiry held in Nairobi last month into the accident to the South African Airways Boeing 707 which made a wheels-up landing at Embakasi on October 30. It had previously touched the ground 9,200ft from the threshold but none of the 78 passengers or crew of 13 was hurt.

Describing the accident, one of the flight engineers said that he saw the approach lights just before the impact. After that, "it looked as though No 3 engine was in trouble—oil pressure and temperature were considerable. Hydraulic fluid was escaping but by the time I had pressed the shut-off button, the gauge was empty."

The runway at Embakasi is 5,327ft above sea level and the obstacle clearance height is 5,650ft. South African Airways' critical height is 600ft but Capt Bird, the co-pilot, said that he had not received written instructions about this. "I feel," said Capt Bird, "that this is laid down as a general guide for crews and the pilots in general feel that if they stuck rigidly to this minimum at certain times of the year, particularly here, the aircraft would seldom get in."

The airline's senior captain, Capt J. Botes, stated that he and his pilots understood critical height to mean the height at which, without precision aids, they must decide whether or not to go lower if they had not seen the lights on the runway. After explaining this definition he was asked by the legal secretary to the High Commission, Mr C. D. Newbold, to whom he had written critical height laid down for the Boeing, if he would try to explain how "South African Airways puts these words down and expects it to mean something else." Capt Botes: "I can't explain it." Mr Newbold: "But would you agree that what you have laid down is, in fact, not a minimum?—"It is broken very, very occasionally and only when the pilot thinks he can get down safely."

Giving evidence, the pilot of the aircraft, Capt Rosslee, said that he agreed with the definition of critical height given by Capt Botes. He went down to the obstacle clearance height and to the best of his knowledge maintained it. He could offer no explanation for the accident.

A theory put forward by Capt Botes was that Capt Rosslee subconsciously reverted to piston-engined techniques on the approach and opened the throttle to lift the nose. "I think he started his rate of descent too fast and never fully recovered until he came below the cloud. What gives me this idea is that the co-pilot started calling out the height every 50ft instead of every 100ft. I think he was getting worried and was letting the captain know. In the jet you must definitely trim it out or use the elevator. Increasing power will not give the nose-up position. From all this I must assume he did go below obstacle clearance height and didn't stop the machine completely from its rate of descent. In the stress of the moment he most probably went back to piston flying."

The chairman and assessors of the inquiry, Mr Justice MacDuff, assisted by Capt I. R. Stephens, a senior BOAC captain, and Col R. H. Preller of the National Transport Commission of South Africa, have reserved their findings. During the inquiry, Embakasi Airport was criticized for lacking ILS; it was subsequently announced that preparation is being made for the installation of this landing aid.

The damaged aircraft is not now to be returned to Seattle for final repairs, which will be completed at Nairobi. It will, however, go back to Boeing next year, along with the second aircraft, for installation of full-length leading edge flaps. The third aircraft, which is soon to be delivered to Johannesburg, is already thus equipped.

*Opened by the Minister of Aviation, Mr Peter Thorneycroft, last Monday, January 9, is the Ariel, the second airport hotel for London to be opened within twelve months. Behind the omni-directional frontage are 186 bedrooms with accommodation for 300 guests. The hotel is air-conditioned, and the rooms are silenced with double windows. Circular corridors (right) are lined with beech wood*

# JP.4: THE ARGUMENT IN 1953

CONSIDERATIONS as to whether it is more practical or more economic to use kerosine or JP.4 "are dwarfed in importance by the positive reduction in the fire risk which is provided by kerosine. The most disastrous aircraft fires following a mishap or minor crash are caused by the ignition of a mixture of vaporized fuel and air, which in certain proportions will burn so rapidly as to prevent the rescue or escape of the occupants of the aircraft. All types of aircraft fuels—gasoline, JP.4 and kerosine—will, when spilled from aircraft tanks, burn rapidly or explode in this fashion under certain specific conditions. In the case of gasoline and JP.4 it can be said that the conditions for the rapid spread of fire always exist, whilst in the case of kerosine the conditions exist only rarely."

This is an extract from a technical discussion, under the heading "Kerosine or JP.4?" published in the *de Havilland Gazette* for August 1953 (which we rediscovered by chance while looking for something else). The article concludes: "No airline with a sense of duty to the travelling public can afford to ignore the implications."

A great deal can happen in aviation in seven and a half years, and nowadays de Havilland are non-committal about the relative safety of kerosine or JP.4. In those days de Havilland were emphasizing that the Ghost-engined Comet, a kerosine-burner, need not use wide-cut gasoline fuels such as JP.4 which, they said, were "at best an expediency made necessary only by the fact that production of kerosine would not be sufficient in the event of a global war. If this factor had not arisen it is likely that kerosine would have remained the universal fuel for jet engines and the temptation to make a virtue out of necessity would not have arisen."

But it would be interesting to know whether de Havilland's fuel experts still privately hold to the opinions they had so long ago. It should be noted that these extracts are taken out of context; but there is no doubt about the main conclusion of the article, which is (to quote again) "that JP.4 cannot be considered as acceptable for commercial operation."

The year previously, also in the *de Havilland Gazette*, Mr J. E. Walker, senior engine installation designer of the de Havilland Aircraft Co (who remains today responsible for these aspects of D.H. design), wrote about fuel systems for turbine-engined aircraft. An extract from this article, again out of context but in no way misrepresenting the author's evident thoughts at that time, is:

"The lower the fuel temperature drops below 30°C [sea level flashpoint of kerosine], and it is seldom above this figure, the more difficult it becomes to start a kerosine fire, while gasoline of 3lb/sq in Reid Vapour Pressure* remains highly dangerous down to −23°C. The significance of this is that in the event of a crash, *unless* this happens immediately after take-off in a hot climate, kerosine must be heated up considerably to enable the flame to travel, whilst gasoline is ready to be ignited immediately. It is this interval before kerosine ignites which gives the crew and passengers in a crashed aircraft a chance of escape and also gives the fire-fighting crews a chance to extinguish the fire before it takes control. This considerable safety advantage now offered to civil aircraft should not be lost by the use of higher-volatility fuels. Kerosine fuel may add more to safety than the heavy and costly fire-preventive measures now being built into aircraft, and whilst it is not suggested that these measures are unnecessary, the combination of modern fire precautions with kerosine fuel can result in a new standard of safety for future civil aircraft."

It seems that Lord Brabazon has only been saying what de Havilland were saying seven or eight years ago.

*"JP.4: An Airline Replies"—pages 51 and 52; leading article, page 39.*

**Typical kerosine RVP is 0.12lb/sq in compared with typical JP.4 RVP of 2-3lb/sq in.*

## THE CHAIRMEN VISIT THE COLLEGE

ON Wednesday of last week the two chairmen of the national airline corporations, Sir Matthew Slattery and Lord Douglas of Kirtleside, had their first joint aviation engagement. They made a tour of inspection of the National College of Air Training, one operational enterprise in which BOAC and BEA have joint participation.

Surprisingly, in view of what had previously been said by the corporations about the dearth of applications from boys wishing to become airline pilots, the chairmen subsequently expressed their optimism about the recruitment of pilots. A photograph appears on page 65.

Sir Matthew Slattery said that prospects for the college were much better than he had expected, that the boys looked a good type for "the most responsible job" of ultimately commanding large airliners full of passengers, and that BOAC did not anticipate any problems at the moment regarding pilot recruitment now that the college was established. Lord Douglas added that it was planned to extend accommodation at the college in later years for up to 300 cadets and this would probably fill pilot requirements for a good many years to come.

BEA say that as part of their recruiting drive they have approached the universities and the 2,500 headmasters of every grammar school and public school in the country. But it might well be asked if sufficient emphasis has been given to attracting the boys themselves; the pilot's profession has more intrinsic appeal than simply that of good prospects and a good salary. So great is the demand for boys with good academic qualifications from industry, the Services and the universities that schoolmasters and school magazines are becoming inundated with recruitment material; the corporations may have to find new ways of appealing for applicants in the advertising campaign upon which they are just embarking.

The magnitude of the task which this campaign must accomplish was given dimension by the principal of the college, AVM E. C. Bates, at the time of the chairmen's visit. He said that, to maintain the high standards the corporations required, for every 100 students who were received into the college 600 applicants were wanted.

## BREVITIES

KLM intend to inaugurate a once-weekly Super Constellation service from Amsterdam to Accra via Zurich, Tunis and Lagos on January 17.

It is understood that Cunard Eagle are negotiating to acquire three Viscounts and two Britannias. Starways also are reported to be negotiating for two Viscounts.

It is reported that Swissair are to order four Caravelles to supplement the four currently leased from SAS, who own the 18 Caravelles operated by the SAS/Swissair consortium.

According to *Aviation Week* the overhaul life of the Ivchenko NK-4 turboprops of Ghana Airways' Il-18s is 500hr and "complete scrapping of the engine after 2,000hr is recommended."

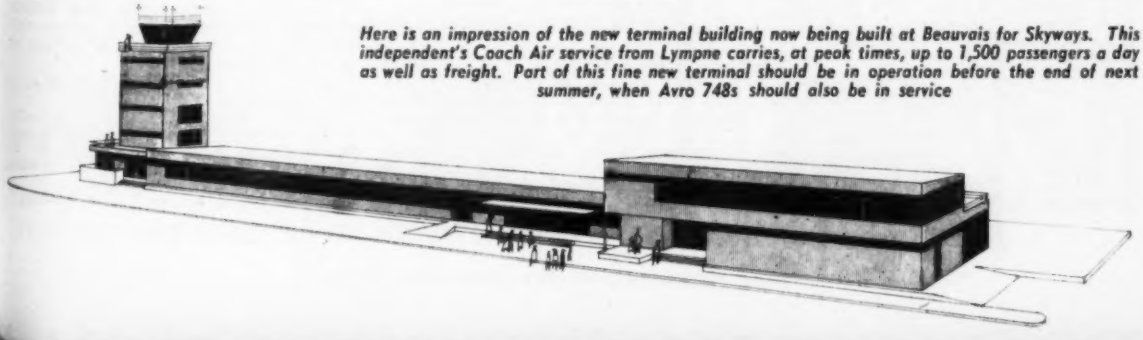
Air-India is planning to buy two more Boeing 707-420s for delivery by March 1962, according to Mr J. R. D. Tata, the chairman. This would increase the Air-India 707 fleet to six.

Cunard Eagle Airways (Bermuda) Ltd has become an active member of IATA as well as Cunard Eagle of London. The Bermuda-registered Cunard Eagle operates the Britannia service to London, and also the scheduled services between Canada and the USA and Nassau and Bermuda.

At the year's end TCA fleet was as follows: seven DC-8s, three Vanguard 952s, 49 Viscounts, 12 Super Constellations, six DC-3s, and 21 DC-4M North Stars (including four retired). TCA withdrew Super Constellations from the North Atlantic route after the last flight on January 1, all services now being operated by DC-8s. Three more DC-8s and 17 more Vanguards will be delivered this year.

An unofficial strike by BOAC and BEA maintenance workers on January 4, which caused the corporations' managements to suspend their pay for one day, led to an extended stoppage which seriously dislocated both BOAC and BEA services on January 4 and January 5. The dispute was over a "totally inadequate" pay rise of 8s 9d to 10s 6d per week, which was subsequently accepted by the union leaders. The men returned to work on January 6.

Capt James Thain, captain of the BEA Elizabethan which crashed at Munich in February 1958, has lost his appeal against his dismissal by the corporation. The NJC, according to BEA, said that "they could find no grounds for upholding his appeal." According to Capt Thain, as reported by *The Times*, at the time of the Munich accident there were no instructions about taking off in slush. Subsequently, BEA set a limit of two inches of slush for take-off, and last month this was reduced to one inch.



***Here is an impression of the new terminal building now being built at Beauvais for Skyways. This independent's Coach Air service from Lympne carries, at peak times, up to 1,500 passengers a day as well as freight. Part of this fine new terminal should be in operation before the end of next summer, when Avro 748s should also be in service***

# SERVICE AVIATION

*Air Force, Naval and Army Flying News*

## Londonderry to Cranwell

NEW assistant commandant at the RAF College, Cranwell, Gp Capt T. P. Seymour was previously RAF Director of the Joint Anti-Submarine School at Londonderry. Before taking up that appointment in 1957 he commanded No 42 Sqn at RAF St Eval, having previously been on Air Plans duties for three years at AIREASTLANT, Northwood. He is a former Cranwell cadet, having entered the College from Blundell's School in 1938. During the war he flew London and Catalina flying-boats with No 240 Sqn, from 1942 to 1943 was a flying instructor at No 4 OTU, then joined No 265 Sqn in the Middle East.

## Commonwealth Honours

TWENTY-NINE members of Commonwealth air forces (RAAF, RNZAF and Royal Rhodesian Air Force) and one USAF officer on loan to the RAAF received honours and awards at New Year. The full list is as follows:—

### HONOURS

#### Order of the British Empire

*Commanders:* Air Cdre T. F. Gill, DSO, RNZAF; Gp Capt R. K. J. Parsons, DSO, DFC, AFC, RAAF.

*Officers:* Wg Cdr J. Hardy, RNZAF; Wg Cdr A. O. G. Wilson, RRAF; Sqn Ldr J. C. Sandercock, RAAF; Wg Cdr B. Catip, DFC, RAAF (CAF).

*Members:* Flt Lt H. C. O'Loughlin, RNZAF; WO (W) C. F. Bryers, RNZAF; WO G. C. McLean, RAAF; WO C. A. W. Lancaster, RAAF; WO R. H. Wylie, RAAF; WO E. J. Sommerlade, RAAF.

### AWARDS

*AFC:* Sqn Ldr L. T. P. Coleman, RRAF; Maj R. N. Fernbaugh, USAF; Flt Lt A. R. Campbell, RNZAF; Flt Lt W. J. Cranfield, RNZAF; Flt Lt J. C. Evison, RNZAF; Flt Lt I. R. Grove, RAAF; Flt Lt C. G. Braithwaite, RAAF.

*ARRC (Second Class):* Sqn Off H. A. Cleary.

*AFM:* F/Sgt P. Antwis, RNZAF.

*BEM (Mil):* F/Sgt J. V. W. Thomas, RNZAF; Sgt G. G. S. Harvey, RNZAF; Sgt A. K. Richardson, RAAF; Sgt C. J. Pearce, RAAF; Sgt C. C. Schiller, RAAF; Sgt V. K. Maloney, RAAF.

*Queen's Commendations for Valuable Service in the Air:* Wg Cdr R. R. Royston, RAAF; Sqn Ldr M. H. Payne, RAAF; Flt Lt R. F. Fox, DFC, RAAF.

## RAF Promotions

NAMES of RAF officers promoted at the New Year to air marshal and air vice-marshal were given last week. Below is a list of other half-yearly promotions:—

#### GD Branch

*Gp Capt to Air Cdre:* A. V. R. Johnstone, H. P. Connolly, J. M. N. Pike, B. R. Macnamara, H. N. G. Wheeler, J. H. Lapsley, L. MacD. Hodges, D. C. Stapleton.

*Wg Cdr to Gp Capt:* P. A. Hughes, R. D. Williams, W. W. T. Ritchie, A. P. Dart, D. F. Rixson, L. T. Bryant-Fenn, B. C. Bennett, D. R. Griffiths, I. B. Butler, D. B. Bretherton, J. A. Brignell, F. Rothwell, J. E. S. Hill, J. L. W. Ellacombe, R. K. Orrock, W. M. Dixon, P. H. G. Wintle, J. A. C. Aiken, K. Ritchley, J. D. Thirlwell.

*Sqn Ldr to Wg Cdr:* R. D. Walton, H. D. Archer, S. M. McGregor, D. B. Wills, R. Le Cudenec, S. Kirtley, G. Strange, J. D. Ackerman, W. E. Pettifer, J. W. J. Leggett, W. G. Wood, R. H. C. Powling, R. Currie, F. C. Ellis, G. M. Smith, K. L. Charney, D. O. Luke, R. Whittam, L. F. Wolsey, C. R. Johnson, R. C. P. Thomson, N. F. Curtis, J. F. C. Melrose, G. F. Clark, J. F. Pinnington, P. Smith, H. T. Brown, J. C. Marmion, C. W. Clark, J. Langston, C. R. Gordon, M. R. Sisley, C. F. Green, W. J. Stacey, A. Maisner, D. F. Hanson, W. N. Gilmer, E. J. A. Patterson, R. A. Slater, R. J. Davenport, J. G. Duncan, S. J. Eaton, W. J. Simpson, C. T. Dalziel, A. G. Steele, J. de M. Severne, E. A. Knighton, V. N. Cramer.

*Sqn Ldr to Wg Cdr (Supplementary List):* H. R. Barrand, F. Jesson.

*Flt Lt to Sqn Ldr:* D. Jackson, L. S. Goodman, B. F. Barnes, K. L. Morris, J. R. Leask, A. M. Laidlay, D. R. Young, D. H. E. Taylor, K. S. Williams, E. J. R. Downs, F. Rimmer, J. N. Elliman, A. B. Walker, J. R. Wilcock, C. Austin, P. M. Worthington, H. M. K. Brown, A. D. Davies, W. G. Wallace, J. P. Douglas, G. T. Smeaton, R. E. Webster, J. F. Knight, P. G. Peacock, W. E. A. Snelling, I. S. MacPherson, J. W. Price, J. C. D. Reeves, D. O. Evans, J. A. Williams, J. A. W. Clubb, K. J. Ryan, J. A. F. Shelley, D. D. Delaney, D. A. Lethem, T. W. A. Devey-Smith, J. R. Powell, I. Cardwell, K. Hayes, T. W. Cooper, J. Fowler, G. H. Cunnington, M. M. Foster, M. G. King, R. L. T. Polgreen, M. Hughes, L. W. Stapleton, A. K. Mosley, G. L. Sheret, D. R. Patrick, I. B. Webster, P. S. Cockman, G. H. Jarvis, E. W. Beer, J. A. Harrison, D. A. H. Mortimer, A. St. C. Wyatt, C. H. Foale, J. M. A. Parker, A. McN. Christie, F. D. Hoskins, R. P. J. King, R. H. Bragg, N. A. Innes-Smith, P. D. M. Moore, J. G. Cruse, J. G. F. Hewitt, A. McK. McVitie, J. Byard, A. B. Musgrave, R. Langstaff, R. A. Tomlin, L. A. Boyer, D. R. Bryan, H. M. Archer, J. M. Pack, M. J. Armitage, T. E. Benson, E. Matthews.

*Flt Lt to Sqn Ldr (Supplementary List):* L. E. Moran, E. G. Jones, A. C. Heath, P. D. F. Drummond-Hay, N. Walling, J. P. Banton, D. V. H. Thomas, R. Chadwick, J. A. Goggin, D. Tasker, C. E. N. O'Rourke.

#### Technical Branch

*Gp Capt to Air Cdre:* J. A. Robinson, B. H. Boon, W. F. Beckwith, J. C. Pope.

*Wg Cdr to Gp Capt:* E. B. Loftus, G. W. Price, A. S. Mohan, K. J. Powell, D. W. Densham, R. T. Morison.

*Sqn Ldr to Wg Cdr:* B. Brown, D. D. Thompson, M. F. Hatton, G. A. Crabb, D. A. Flint, W. Edwards, F. Bellam, G. E. F. Johnson, W. Wilkinson, D. J. Vanstone, G. Young, J. J. S. Hirons, K. G. Thomson, H. J. Lavery, H. F. Glover, N. F. Searle, D. A. McF. Walker, F. C. Airey, R. H. Johnson.

*Flt Lt to Sqn Ldr:* F. Fallon, T. C. Downard, A. E. Oldham, F. L. Finch, R. A. Cunningham, C. G. Wing, G. Cairns, E. E. Lake, D. Woods, P. J. Gibbs, R. A. Topp, K. C. Skillman, E. A. Barrett, E. B. R. Goldsmith, R. E. Lovelace, D. A. Ward, J. E. Moore, F. McL. Holmes, H. Barrett, D. G. McL. Moore, R. G. Rowe, G. R. Moore, J. D. Burgess, J. T. Fletcher, C. R. Long, B. E. Evershed, D. Biltcliffe, A. R. Fox, D. E. Card, D. F. Greenwood, J. F. Daly, C. Thomas.

*Flt Lt to Sqn Ldr (Supplementary List):* H. L. Davies, R. H. McCullough, R. W. L. Trenam, S. James, A. Dicken, F. A. H. Jenkins, W. Wasilewski, B. E. H. Merewood, M. E. Price, F. H. Perry, T. Colley, G. P. White, F. H. Lawrence, R. Dixon, G. A. Stemp, C. O. Thatcher, B. Ewart, R. C. Phillips.

#### Equipment Branch

*Gp Capt to Air Cdre:* S. G. Walker.

*Wg Cdr to Gp Capt:* S. L. Swain, J. E. M. Mould.

*Sqn Ldr to Wg Cdr:* F. J. P. Haynes, D. Field, W. R. Brooks, J. G. Ireton, C. H. Tamsett, L. Pearman, W. G. Carr.

*Flt Lt to Sqn Ldr:* B. B. Booth, V. R. Withey, S. Jackson, S. A. Lamb, E. T. Moore, J. J. R. Crichton, R. D. Feek, A. Harris, J. Lawrence, R. M. Rogers, P. J. Probyn, J. Hammond, K. A. E. Smith, S. O. O. Marshall, G. B. Wood, A. R. Martindale, M. L. Cann.

*First overseas pilot to fly solo in the Westland Gnome Whirlwind: Lt Cdr Colin M. Wheatley of the Royal Australian Navy, who is in England for the purpose of evaluating the aircraft, seen in the cockpit before his flight*

*Flt Lt to Sqn Ldr (Supplementary List):* W. K. Foote, L. F. Johnson, R. E. C. Finch, B. W. L. Hidden, C. C. A. Luter.

#### Secretarial Branch

*Gp Capt to Air Cdre:* C. G. Stowell.

*Wg Cdr to Gp Capt:* E. J. C. Smither, C. H. Wiggins.

*Sqn Ldr to Wg Cdr:* W. P. Hopkin, I. E. Miller, P. F. Smith, T. Stafford, P. A. H. Moon, W. A. Harrison, G. Cubby, F. T. Russell, W. Smith.

*Flt Lt to Sqn Ldr:* T. Lockwood, M. G. Elliot, G. C. Rowland, G. F. Tisley, J. W. Partridge, G. N. Bray, J. F. Williams, R. J. Gardiner, R. L. Allen, P. E. Raymond, T. E. Harrison, C. A. Room, S. H. D. Weigall.

*Flt Lt to Sqn Ldr (Supplementary List):* K. G. Sharp, W. L. Grout, F. J. E. Ison, C. E. Roberts.

*Flt Off to Sqn Off (WRAF):* B. C. Stannard, E. N. Campbell.

#### RAF Regiment

*Sqn Ldr to Wg Cdr:* F. A. Hall.

*Flt Lt to Sqn Ldr:* W. M. C. Skinner, P. B. Robinson, B. S. Bridges, K. M. Oliver.

#### Marine Branch

*Sqn Ldr to Wg Cdr:* D. T. Beamish.

#### Medical Branch

*Gp Capt to Air Cdre:* C. C. Barker, G. R. Gunn.

*Wg Cdr to Gp Capt:* J. A. MacCarthy.

#### Legal Branch

*Wg Cdr to Gp Capt:* A. Sidney-Wilmot.

*Sqn Ldr to Wg Cdr:* E. E. W. Lloyd-Jones.

#### Education Branch

*Gp Capt to Air Cdre:* A. A. McGregor.

*Wg Cdr to Gp Capt (Supplementary List):* E. J. Tippett.

*Sqn Ldr to Wg Cdr:* E. Essame, T. J. Mair.

#### Provost Branch

*Sqn Ldr to Wg Cdr:* A. A. Witherington.

*Flt Lt to Sqn Ldr:* E. O. Kennedy.

*Fg Off to Flt Lt:* J. P. Magurn, G. A. Hickey, G. O. Thomas.

*Fg Off to Flt Lt (Supplementary List):* P. H. G. Atkinson, M. J. Limb.

#### Catering Branch

*Flt Lt to Sqn Ldr:* J. G. Chew, F. Kornicki, D. A. Beasley, J. Swaffield.

*Flt Lt to Sqn Ldr (Supplementary List):* H. T. W. Houghton, A. E. Allsopp.

#### Physical Fitness Branch

*Sqn Ldr to Wg Cdr:* W. J. Randall.

*Flt Lt to Sqn Ldr:* D. M. Brown, G. R. Edenbrow, J. A. M. Davies.

*Flt Lt to Sqn Ldr (Supplementary List):* F. J. Harrison.

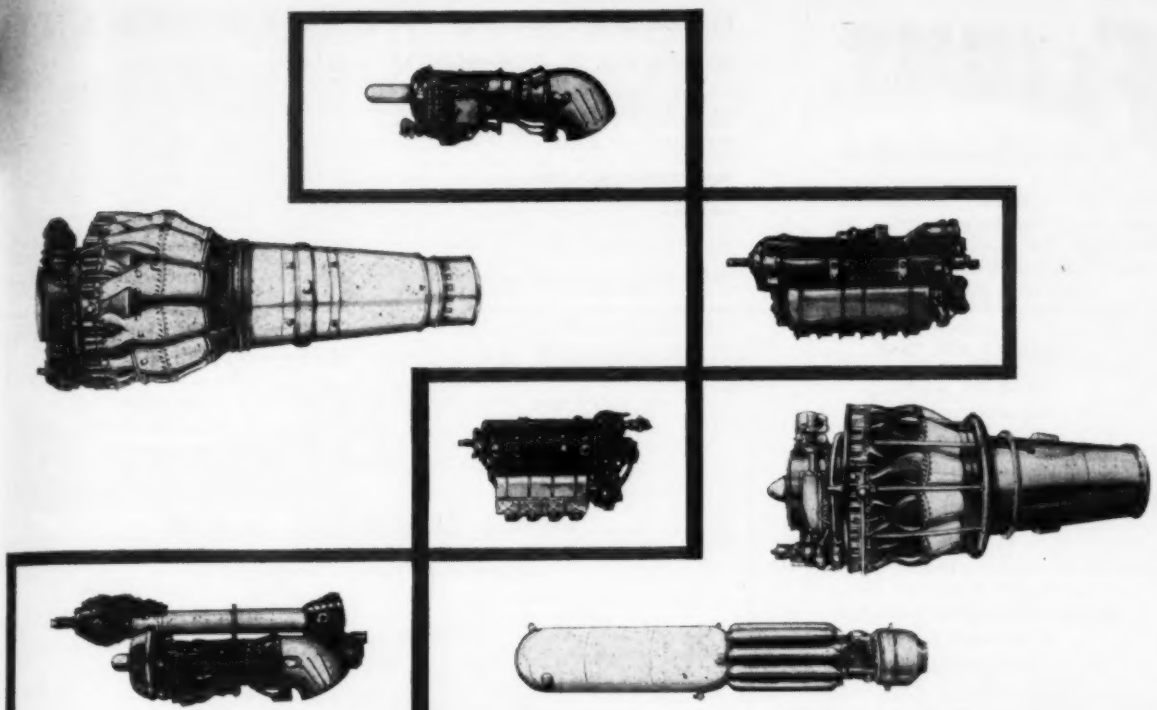
## FAA Promotions

PROVISIONAL RN promotions, dating from January 1 this year, include the following Fleet Air Arm officers and RN officers serving in aircraft carriers or at air establishments:—

*Cdr to Capt:* E. G. Brown, R. H. Webber, K. R. Hickson, J. E. Dyer-Smith.

*Lt Cdr to Cdr:* G. J. R. Elgar, A. J. Leahy, B. M. Tobey, T. C. Evans, D. T. McKeown, W. J. Carter, R. K. Midgley, D. W. G. Robotham, C. M. Little, C. R. Heaton, G. W. K. Whittaker, H. A. Minns.

*Surgeon Lt Cdr to Cdr:* J. S. P. Rawlins.



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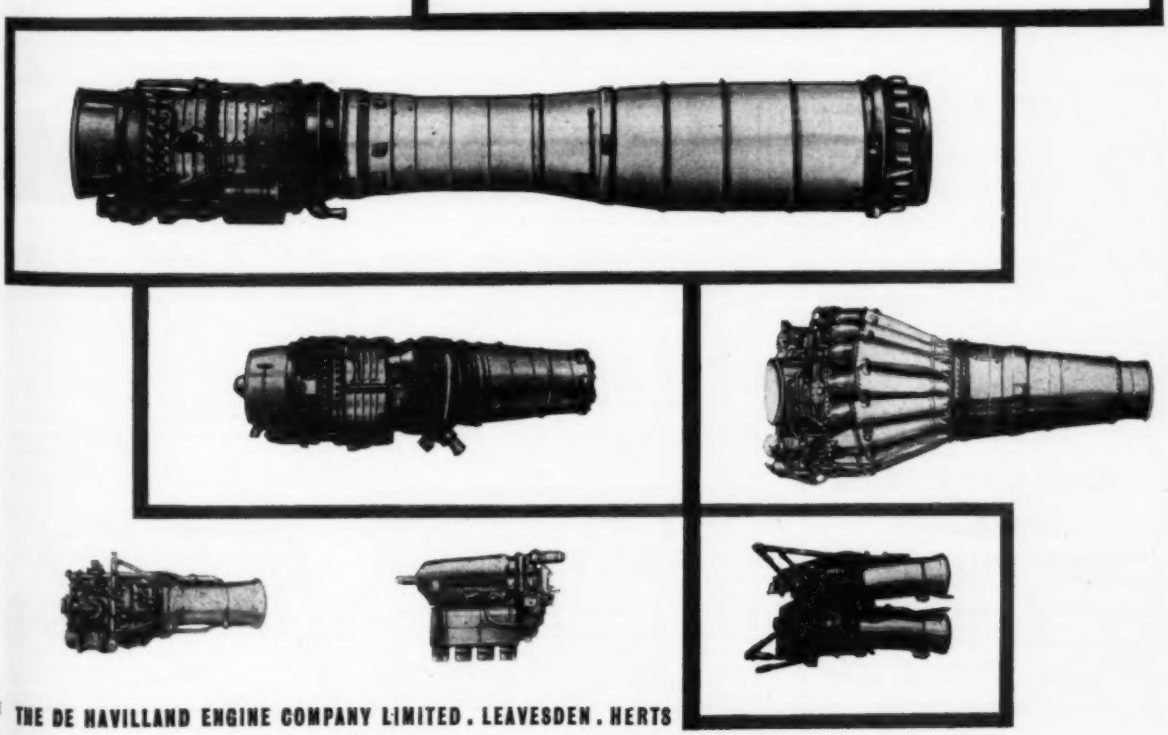

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AUSTER AUTOCRAT. Cirrus II, 300 hours S.C.O., radio, starter, generator, silencer, battery, full panel, new tyres. C. of A. May 1961. £1,350. Below.

AUSTER AUTOCRAT. Cirrus II, 70 hours S.C.O. Nil hours since C. of A. and respray. £1,000. Below.

JACKAROO. Gipsy Major, 1,430 hours S.C.O., silencer, dual, four seats, with new C. of A. £950. Below.

DAVID RIMMER AVIATION (Sales), Waltham St. Lawrence, Reading. Shurlock Row 210. [1726

**1959** BEECHCRAFT TRAVEL AIR 95, blue/silver, engine hours nil since major overhaul, regularly maintained. STR12D. Narco Omnigator, Sunair RTR. Lear 12E. Demonstration by arrangement at short notice. Box No. 2693. [0062

THE aircraft with the "mostest"—the Jodel D.140 Mousquetaire. 4 to 5 seats, over 200 lb. baggage with 4 seats occupied, cruises 145 m.p.h. on 7 gallons per hour, range over 850 miles. Cost? £10,000? £7,500?—No. Only £4,500 delivered United Kingdom, duty paid. Write or phone, Rollason Aircraft & Engines Limited, Croydon Airport, Surrey. Telephone Croydon 5151/2. [0130/1

FAIREY FIREFLY AIRCRAFT with Rolls-Royce Griffon XII Engines. A number of these aircraft offered for sale, in good flying condition, together with spares. Two with dual control. SAAB 91A Aircraft, with Gipsy Major 10 Engines. A number of these aircraft offered for sale in good flying condition. Further particulars from Cournede & Farquharson Limited, 6 York Street, Twickenham, Middlesex. Tel.: POPesgrove 7524, 7562. [1581

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*ALWH was built in 1950 and has flown 2580 hours since new. Leonides 503/4 engines now have extended life to 850 hours and those installed have run 447 and 170 hours since complete overhaul. Propellers only 274 each out of an available 1000 hours. Certificate of Airworthiness expires April 22nd 1961.

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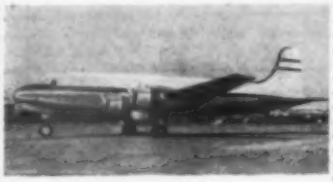

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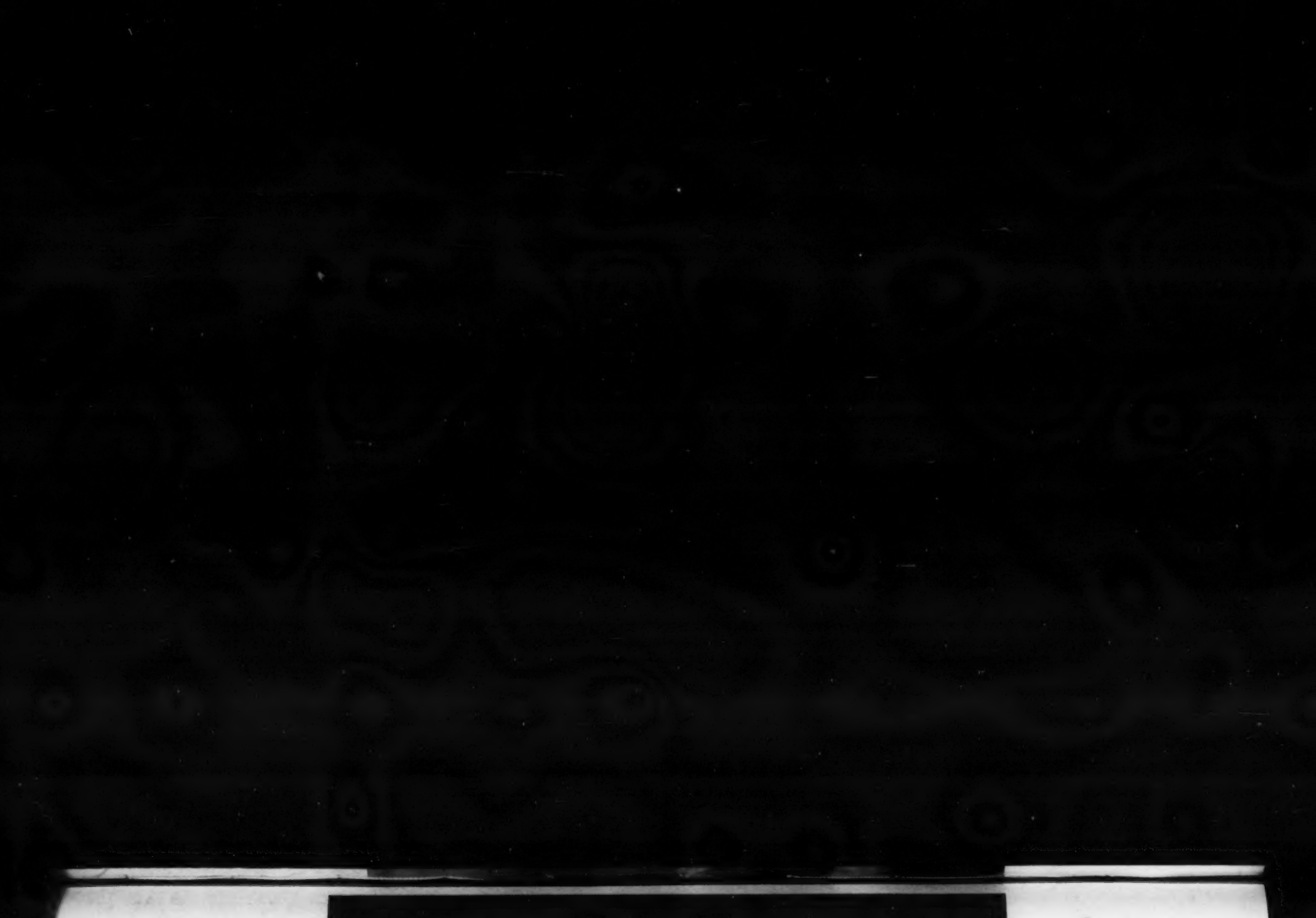
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